THE INTERNATIONAL SUGAR JOURNAL

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NOTES AND COMMENTS.

The Price of Sugar.

The campaign in the Radical Press against the Brussels Convention on account of the rise in the price of sugar shows little sign of abatement. Misstatements continue to be bandied about without limitation, on the principle that any stick is good enough to beat a dog with. One individual, a confectioners' machinery engineer by profession, has evidently found business so slack that he has had time to flood the press of the whole country with letters, in which he poses as an expert on the sugar question, and denounces the Brussels Convention and all its works. He might inquire into certain reports to the effect that foreign machinery has recently been installed in several confectionery works in this country. A protest in this case would be more in his line.

We are glad to see, though, that some telling refutations of the confectioners' statements have been published from time to time. A letter from Mr. King, a chocolate and cocoa manufacturer in Bristol to the *Bristol Times*, which we give elsewhere, is a timely exposure of the charge levelled at the Brussels Convention that it had thrown so many men in confectionery works out of employment. There are clearly other more accurate reasons than the Brussels Convention for depriving these men of their work, but it does not suit the purpose of the agitators to proclaim them.

The most favourite weapon in the cheap-sugar agitator's armoury is the statement that but for the Convention sugar from Russia and Argentina could enter this country. But such sugar could not exceed 100,000 tons in quantity, and had bounties continued, we should have had a much larger loss in cane sugar to set against that gain. As the West India Committee have pointed out, the following countries would very shortly have more or less ceased to produce:—

Java, Brazil, British West Indies, San Domingo, Mexico and others, Mauritius, Peru.

Their present total output is about two million tons. We have every reason for knowing that great relief was felt both in Java and Hawaii when the Brussels Convention was drawn up and signed, as all the manufacturers had realized that the low prices of 1902 were simply ruinous to them. And these two countries are the most up-to-date sugar producing areas in the world.

Given favourable weather in a fair number of the great cane producing countries, next year's cane crop should be one of the largest on record. There is considerable competition being shown to secure old abandoned sugar estates with a view to restarting them. This is specially the case in Jamaica, and we think this island, if it will only embark seriously and extensively on the enterprise, will ere long prove one of our best sources of supply. But new and up-to-date machinery is a *sine qua non;* we believe in most instances it will speedily be forthcoming, as the high prices for sugar which have been ruling of late have proved a great stimulant in rousing estate owners to the possibilities of the future.

West Indian Agricultural Conference, 1905.

This Conference is being held this month at Trinidad, and promises to be the most successful one ever held. A lengthy programme of papers has been drawn up. The Sugar Industry Section will include the following papers:—

Review of the principal Fungoid Diseases affecting the Sugar Cane (Mr. Lewton-Brain, B.A.).

Review of the Treatment of Insect Pests affecting the Sugar Cane (Mr. Henry A. Ballou, B.Sc.).

Field Treatment of Cane Tops for planting purposes.

Cane Farming in British Guiana and Trinidad.

On the Polarimetric Determination of Sucrose (Hon. F. Watts, C.M.G., and Mr. Harold Tempany, B.Sc.).

On the Central Sugar Factory in course of erection in Antigua.

Besides sugar, the cacao, fruit, and cotton industries will be dealt with.

East African Sugar.

Probably few people are aware that a flourishing sugar plantation exists on the Matambe River, Inhambane, Portuguese East Africa. Formerly cane was grown there by Portuguese for the manufacture of an intoxicating liquor for natives, but this was stopped by the Government in the interests of Portuguese wines, and then Messrs. Donaldson and Sivewright, of Johannesburg, were approached with a view to the establishment of a proper sugar industry, the land being eminently suitable for the purpose. A small sugar plant was sent to the spot, and the Inhambane Sugar Estates was floated with a capital of £30,000. This development took place towards the end of 1902, and, last year, from a small plantation, 130 tons of sugar were obtained, realising an average price on the estate of £16 10s. per ton. This year a crop of 250 or 300 tons is expected, and next year a yield of 750 tons. The estate contains five or six thousand acres, of which fifteen hundred form what is considered to be the best sugar land in Africa. Altogether some 450 acres are at present under cultivation, and the other thousand acres or more will be utilised by degrees. Labour is very plentiful, the estate being situated in the Shangaan country, and wages amount to 7s. a month, as against the 30s. paid on the Natal sugar estates. Owing to the richness of the soil and the suitability of the climate, a yield of two tons per acre is confidently anticipated, whereas in Natal the yield amounts to about one ton and a quarter per acre. In Lourenço Marques, the sugar, which is taken there in boats, realises £27 10s. per ton. Most of the sugar is grown for export to Lisbon, where a rebate of half the duty is made on account of its colonial manufacture.—(*African Review.*)

Peru.

Peru has many natural advantages for sugar growing and compares favourably with the best parts of Hawaii. Analyses of her soils show them to be rich, and the canes are good. In general the latter have a high per cent. of sugar, high fibre, low moisture, low glucose and high purity. Occasionally the sugar in juice will run as high as 21 with a Brix. of 22 to 23, and a fibre of 16; but in general the canes give juice, 20; Brix. 18 to 18·50; and fibre 14·50 to 15. The purity of the juice is about 92.

THE FRENCH SYSTEM OF NOT REFINING IN BOND.

Thirty years ago the international discussions raged around this subject alone. The French declared that they would levy their duty on the analysis of the sugar. Saccharimetry was the bone of contention; but the British delegates stuck to their text, and would have nothing but refining in bond pure and simple, no duty levied, and therefore no drawback on exports. Duty to be levied only on the sugar going into consumption. It was a simple, practicable, and efficient means of abolishing bounties. But our Government had no courage to insist and compel, and the dispute, after three conferences, died away. Then the French Government, for the benefit of their revenue, adopted saccharimetry, but without supervision or checking of quantities really produced. It was a first step in the right direction, and the bounties were reduced—scotched, but not killed. At a later period they added a sort of supervision, a curious make-believe. They professed to check the quantity of sugar—not made, turned out and delivered, that would have been too simple—but the quantity of sugar supposed by analysis to be lost in the molasses. They declared this to be perfection; they found it to agree to a kilogramme with the theoretical quantity. The pertinent question, "How about the quantity allowed for loss of weight in refining?" they answered, airily, by declaring that it was definitely lost, and that, if anything, the allowance was too small.

Now they have been compelled by the Permanent Commission to weigh the actual sugar produced, and they profess to do so. What is the result? The reply is an interesting commentary on all that has gone before, and shows how little reliance can be placed on "assurances."

The reporter of the Budget Commission has just issued his report with regard to the estimates of revenue from sugar for 1904-1905. He gives elaborate details of the revenue for the past two years, and rectifies them by estimating how much sugar was held back from consumption in anticipation of the great reduction in duty on the 1st September, 1903, and how much was consequently consumed in 1903-4 in excess of the normal consumption. The result of this rectification gives him the following figures as the natural consumption in the two years:—

	Tons.
1902-3	455,752
1903-4	613,944

The reduction of duty has therefore created an increased consumption of 34·7 per cent. Since then this increase over 1902-3 has been maintained, and he therefore bases his estimate of revenue on that figure.

But he makes a further addition to his estimate of revenue; and this is the point to which we desire to direct attention. He refers to the "change of legislation brought about by the new law with regard to the refineries." This, he says, "will in fact permit us to recover *the bounty (les bonis)* which the refiners were enabled to enjoy up to this time from the deduction of 1½ per cent. which was allowed them."

Here at last, after thirty years, the cat has been let out of the bag. This is what the assurances of the French Government are worth in this matter of sugar. The reporter continues:—"If, as seems to have been admitted at Brussels, this deduction was an exaggerated one to the extent of half, we can estimate the extra revenue at 0·75 per cent. of the duty on refined sugar, that is, at about 800,000 francs. We propose, therefore, to increase by so much the product of the sugar duty for 1905."

The question naturally arises, how much more will they credit the revenue with when they adopt, like all the other countries, refining in bond, *with no drawback on exportation?*

We are pleased to see, in the *Journal des Fabricants de Sucre* of the 14th December, that our contemporary quotes, *in extenso*, our remarks on this subject in our December number, and that he adds: "Nothing can be more true" *(rien de plus juste)*. "But," he continues, "the French Government does not seem in any hurry to bring to an end this irritating question."

It is clear that the irritation must be kept up a little longer.

The *Journal des Fabricants de Sucre*, in its review of the year, says:—

"From the point of view of legislation . . . it is necessary to recall the law of 9th July, 1904, establishing the permanent supervision of the sugar refineries by the Excise officers. This new system, instituted in accordance with the representations laid before the permanent Commission at Brussels, has given rise, in Germany and England, to considerable criticism. It is essential for our good name that the French Government should speedily remedy the imperfections of this *régime*."

The "representations laid before the permanent Commission" were that France had failed to establish refining *in bond*, with abolition of drawbacks on export. The new system, therefore, is not "in accordance with the representations," and can only become so by the total abolition in France—as in all the other countries—of drawbacks on export. There is no other remedy; and no other remedy will ever be accepted by this country.

THE PRICE OF SUGAR.

The following letter appeared in *The Times* of 9th December:—

To the Editor of the Times.

Sir,—It is difficult to make the general public understand how absolutely unfounded is the present cry that the abolition of bounties has made sugar dearer. The following figures will convince any one who will have the patience to read them carefully.

The European beetroot crop of 1901–2, stimulated by enormous cartel and other bounties, produced 6,720,000 tons of sugar. The supply was so excessive that prices went down to 6s. per cwt., which is at least 3s. per cwt. below the European average cost of production. At the end of that season, on September 1, 1902, the account stood as follows:—

	Tons.
World's stocks, September 1, 1901	1,086,000
World's visible production, 1901–2..	10,964,000
Total supplies, 1901–2	12,050,000
World's visible consumption, 1901–2	10,004,000
Stocks, September 1, 1902	2,046,000

This stock was about 1,500,000 tons in excess of the requirements to carry us over into the new crop. This, and the ruinous price, caused the sowings to be reduced in the spring of 1902, in spite of the fact that the bounties would continue for another 18 months. The beetroot sugar production in Europe amounted in 1902-3 to 5,570,000 tons, a reduction of 1,150,000 tons, and prices recovered—prematurely, as it turned out—to 8s. per cwt., a price still below the European average cost of production.

It is evident that this reduced production and increased price was the effect of the over-production caused by the bounties, not of the distant prospect of their abolition 18 months afterwards.

But in spite of this reduction the glut of sugar caused by bounties continued, as shown by the account at the end of the season 1902–3:—

	Tons.
Stocks, September 1, 1902	2,046,000
World's visible production, 1902–3..	9,912,000
Total supplies, 1902–3	11,958,000
World's visible consumption, 1902–3	9,915,000
Stocks, September 1, 1903	2,043,000

In 1903 the European beetroot crop was increased to 5,880,000 tons, in spite of the fact that bounties were about to be abolished before the sugar could come on the market. This increase was quite justified by the anticipated increase in European consumption when

duties and surtaxes were reduced. The account at the end of the season stood thus:—

	Tons.
Stocks, September 1, 1903	2,043,000
World's visible production, 1903–4	10,403,000
Total supplies, 1903–4	12,446,000
World's visible consumption, 1903–4	11,019,000
Stocks, September 1, 1904	1,427,000

Thus the excessive stocks had been reduced from 2,043,000 tons to 1,427,000 tons. This was still excessive and had been fully anticipated. Prices therefore for some months at the beginning of this year remained at the low figure of 8s. to 8s. 6d. per cwt.

Clearly the abolition of bounties had had nothing to do with this small rise in the price of sugar. If the beetroot crop this year had given a normal yield, it would have produced about 5,700,000 tons of sugar. We have also a reliable estimate of what the rest of the world will produce, and can, therefore, frame a prospective account of how matters would have stood at the end of the season. The consumption will not attain the figure of last season, which was abnormal owing to the depletion of invisible stocks previous to the European reductions of duty on September 1, 1903. But, even taking it at nearly that figure, we get the following account for 1904–5:—

	Tons.
Stocks, September 1, 1904	1,427,000
European beetroot crop, about	5,700,000
The rest of the world's production	4,782,000
Total supplies, 1904–5	11,909,000
World's consumption, say even	11,000,000
Stocks, September 1, 1905	909,000

This is more than enough to carry us over to the new crop, and would have justified no rise in the price of sugar, a fact confirmed by the quotations for the first three months of this year.

But when the summer came it was evident that the new beetroot crop was in great danger from persistent dry weather, and prices began to rise, standing at 9s. 7½d. on July 1. At a later period, when reliable estimates of the crop could be made, it was found that, instead of 5,700,000 tons of sugar, it would not, even at the most sanguine estimate, yield more than 4,950,000 tons. The account at the end of the season will, therefore, be:—

	Tons.
Stocks, September 1, 1904	1,427,000
Estimated European beetroot crop	4,950,000
The rest of the world's production	4,782,000
Total supplies, 1904–5	11,159,000

Consumption must evidently be reduced or we shall have no stock to carry us on into the next crop.

The present situation is another instance out of many that have occurred during the last 20 years of bounties, showing how completely the bounties have made the world's price of sugar dependent on the state of the beetroot crop. Now that bounties are abolished we shall gradually but slowly escape from this bondage. Free competition will allow sugar to be produced in larger quantities elsewhere, and probably in some new countries, so that eventually the beetroot crop, though still remaining an important factor, will cease to be so absolutely the governing factor in the price of sugar.

Messrs. Icke and Sharp, in their reply to Mr. Chamberlain, as published in *The Times* of Saturday, do not hesitate to repeat the unfounded assertion that the Brusels Convention "increases the price to us." I have shown that at all events the present increase of price is not in any way due to the Brussels Convention, except in so far as it has increased the consumption of sugar—a great blessing to all producers. But let us look a little deeper into the question, beyond the mere figures of the present situation. The bounties created "glut, collapse, and ruin," as the late Lord Farrer very truly said. The glut gave us for the time very low prices, the inevitable collapse brings reduced production, a temporary scarcity and high prices. The confectioners would have liked to have sugar provided for them in perpetuity at the price of 1902, which was 3s. per cwt. below the cost of production, and they cry out loudly because a reduced supply—not caused by the Convention—has deprived them of that impossible boon. But what would have happened if bounties had continued and the price of 1902 had been maintained a little longer? Not only would every natural producer have been shut up, but even the smaller bounty-fed ones would have been driven out of competition. Your readers can easily imagine what the price of the sugar would have been under those circumstances, and may wonder what the confectioners would have said then. This is a lesson for fiscal reformers to ponder over; still more for those who oppose reform and declare artificial cheapness to be "free trade."

I am, sir, yours faithfully,

GEORGE MARTINEAU.

Gomshall, December 5.

On the same day a leading article appeared in *The Times* dealing with the whole question.

Beginning with the complaints of the confectioners and mineral water manufacturers, the writer points out the absurdity of the complaint as regards the latter industry.

"When we consider that a very large part of their mineral water output contains no sugar whatever, that the quantity in a bottle of

their sweetened products must at any price of sugar represent a minute fraction of the cost, and that they will probably know how to reduce that quantity considerably without affecting their sales, the conclusion can hardly be avoided that, if the present rise in sugar is going to injure them much, their trade must be in a very precarious condition."

The confectioners are dealt with in the same trenchant and conclusive manner; and, incidentally, the letter of Mr. Lough, M.P., is characterised as "bristling with fallacies and incoherences to such an extent that it would be hard to know where to begin his refutation."

The confectioners declare that they always predicted melancholy consequences from the Brussels Convention. So they did.

"If the confectioners knew that sugar would rise under the Convention, why did they not cover themselves by prudent buying and forward contracts when sugar was cheap? It was quite cheap until March of this year—(the writer might have said 'May')—that is to say, it could be obtained in large quantities rather under the average European cost of production. If they did not buy, what are we to infer? Surely that they did not, upon better consideration, believe in their own predictions, and thought it wiser to buy from hand to mouth. If that was their conclusion—and any other would reflect gravely upon their business capacity—they would have been justified by events, had events followed their natural course."

The article then points out the real cause of the rise—the continental drought—which affected the beetroot crop so seriously that, "though about the same acreage was sown, the produce is estimated to fall short by close upon a million tons. That wipes out the carry-over reserve; there is a shortage in the supply; and price has risen accordingly."

The writer proceeds to refer to figures given in the letters from Mr. Martineau and Messrs. Henry Tate & Sons, and continues:—

"The rise in sugar would have occurred had the Convention never been heard of, and in the opinion of Mr. Martineau and of Tate and Sons, who know quite as much about the matter as the confectioners, the price would have been higher than it is had the bounty system remained in force, because the Cartels would have had us at their mercy."

The confectioners are then urged to look at the average price of sugar. They "must average dear with cheap years, just as they had to average equally great fluctuations under the bounty system." The writer might have said "much greater fluctuations under the bounty system."

This outcry "shows the wisdom of the Government in setting its face against industrial protection, as opposed to the beating down of artificial legislative obstacles to our trade."

"It is always protected trades that make the greatest outcry. The confectioners have been enjoying protection, which gave them sugar under cost of production, and we see what a noise they make when natural conditions regain free scope. . . . . The country will shortly have sugar prices upon a much more stable basis than was possible under bounties and Cartels. There is not the least reason to doubt the prediction of experts that for ten years following the Convention the price of sugar will, on the average, be at least as low as for the ten years preceding it."

The Sugar Convention, *The Times* declares, is an excellent thing, although it cannot counteract the effects of wind and weather on the sugar crop. Quite so, but the effect of the Convention will be to relieve us of our present position in being dependent for our supplies on the artificially stimulated beetroot industry, prices being governed by the state of that crop.

"Our colonies reap an immediate benefit, and confer one upon us. But for increased cane production present prices would be higher than they are, and as the area of production widens we become more and more independent, alike of weather and of the action of gigantic Continental trusts."

THE CONFECTIONERS' TRADE: ACCORDING TO THEMSELVES.

The following letters are such a thorough exposure of some of the arguments used by the confectioners in their campaign of calumny against the Brussels Convention that we make no apology for reproducing them :—

To the Editor of "The Standard."

Sir,—I fancy the outcry against the Government which one reads in the Liberal papers is being worked up by them for more than it is worth to that Party. How is it there is seldom any allusion to the constantly-increasing competition in the jam, sweets, biscuit, and cake trades, or to the large number of rivals who have come into the field of late years? Soon after the Sugar Convention, when the rise in price was hardly appreciable, a client of mine, in the wholesale sweet trade in a country town, asked me to guess the selling price of some nice looking bottled sweets. I did, and was not near the mark; the figure astounded me. At 4d. per lb. retail it left a fair profit to the shopkeeper. He then told me, as profits were getting so small, he intended to retire, to make sure of his money by having a residence built on a site intended for a new manufactory, leaving to his sons the existing business. Also, how many millions sterling have been artfully withdrawn during the past ten or fifteen years from some of the better-known firms in these trades by the older proprietors (some of them pious men), who, scenting smaller profits ahead, took advantage, when practicable, of the Companies

Acts by adding that blessed word "Limited," and thus selling their property at an inflated value to a gullible public?

I remember in the good old times, when, if sugar went up a farthing or halfpenny per lb., or other raw material a few shillings a sack, and my firm considered it imprudent to revise price lists, they made no fuss, but accepted the situation with serenity. Nowadays it appears that a similar rise in prices means bankruptcy, unless the Board of Directors, struggling with insufficient working capital, go for the employes, discharging the oldest servants first, or "shut down" part of the machinery, &c.

As regards foreign competition, excepting chocolate goods, the home manufacturer is likely to hold his own for some time yet, as the Continental make is unsuitable for our markets.

I am, Sir, your obedient servant,

A RADICAL.

December 14.

TO THE EDITOR OF "THE BRISTOL TIMES."

Sir,—The correspondence in your paper *re* advance in the price of sugar has been very interesting; but some of the statements respecting the action of the abolition of the bounty, and men losing their employment through the Sugar Convention, will not bear investigation.

All manufacturers wish to buy sugar and all materials they use as cheaply as possible, to enable them to meet the very severe competition; but nothing, in my opinion, upsets a manufacturing trade so much as very low prices for a short time, such as in 1902, when refined sugar could be bought at 7s. 4½d. per cwt. f.o.b. (about 4s. under the cost of production). These prices induced some manufacturing con'ectioners and chocolate makers to reduce their prices, in some cases even lower than they were before the 4s. 2d. duty was imposed in 1901. It is the most easy thing to lower prices, but very difficult to raise them; hence the great outcry of sugar being dear.

I have known something of the sugar trade since 1877, and from that time prices have varied from 35s. per cwt. (without duty) in 1877 to 7s. 4½d. in 1902, and not until 1884 was granulated sugar under 20s. per cwt. From that date to 1889 it varied a few shillings; in that year it reached 26s., and again there was a falling market until 1893, when it again advanced to 23s. There was no great variation until 1902, when it reached the lowest price ever known, viz., 7s. 4½d. per cwt.; and since that date there has been a gradual rise to 16s., due to abolition of bounties, speculation, and larger consumption in the countries of its production.

Some correspondents have shown an utter disregard to the well-doing of any trade but their own in advocating a return of the bounty system which would mean closing the refineries that have resumed work. Several of your correspondents have stated that many men had lost their employment through dear sugar. Will these statements bear investigation? Would it not be fair to see if there are other reasons besides the Convention which are the cause of these men in the cocoa and chocolate trade losing their employment? Has there not been erected at a cocoa factory in

Bristol a very extensive labour-saving plant, which has replaced the services of over one hundred hands? Can this be ascribed to the Convention?

That the cocoa and chocolate trade has not been in as flourishing a condition as it ought to be there is no question, but we have to look to other causes than the Convention for the reason, two of which, at least, can be ascribed to the cheapness of fruit and the general slackness of trade.

There is an old saying, "You cannot eat your cake and have it too." Supposing we alter it a little, and say we cannot import manufactured cocoa and chocolate and have the same quantity to manufacture. Examine the figures as given in the trade returns—the imports of "Cocoa and chocolate, ground, prepared, or in any way manufactured:—

	lb.	Value. £
1899	5,152,640	503,106
1900	7,754,879	719,871
1901	8,329,574	861,098
1902	8,748,353	895,587
1903	10,446,713	1,035,342

These figures show that during the 1903 there was imported 10,446,713 lb. of manufactured cocoa and chocolate—an increase in five years of 5,294,073 lb. This works out at an average price of 1s. 11¾d. per lb. If this had been manufactured in Britain it would have found constant employment for at least 3,000 hands at 25s. per week. Looking at these figures, and taking them in conjunction with our exports to foreign countries for the same periods, our trade has declined from 616,600 lb. in 1899 to 403,055 lb. in 1903, and the value works out at about 1s. per lb. on all cocoa and chocolate exported. The manufacturers can obtain a drawback of 4s. 2d. per cwt. from the Customs on all sugar used in the manufacture of cocoa and chocolate and all confectionery.

I would ask everyone interested to examine the trade returns, and I venture to think there would be a large number who would admit there was something in Mr. Chamberlain's scheme of Fiscal Reform not lightly to be put aside, but which is worthy of full and impartial consideration at the hands of those who desire to find an explanation for the unsatisfactory condition of this and many other trades.

Yours truly,

RICHARD KING.

Cocoa and Chocolate Manufacturers,

Waterloo Road, Bristol, December 14th.

It is not the case that the consumption of sugar has increased everywhere on the Continent; as a matter of fact, it is 28 % below the average in Austria-Hungary owing to the high prices ruling.

WORK OF THE PERMANENT COMMITTEE OF THE BRUSSELS SUGAR CONVENTION.

According to the *Wochenschrift des Centralvereins für Rübenzucker-industrie*, published in Vienna, the Permanent Committee of the Brussels Sugar Convention accomplished the following work during its recent session:—

(1) *Countervailing Duties for Sugar from the following countries: Chile.*—The import duty for refined sugar in lumps or crushed being 14 pesos 35 centavos, equal to francs 25·83, the countervailing duty after deducting the surtax of francs 6·00 amounts to francs 9·91, and with the addition of the direct bounty of francs 3·60, the total countervailing duty on such sugar is francs 13·51 per 100 kilograms. The duty on sand sugar and ground sugar is 11 pesos 4 centavos, equal to francs 20·51. The countervailing duty on these sugars is, therefore, with the addition of the direct bounty, francs 10·86. First product granulated and cassonade pay an import duty of 6 pesos 50 centavos, equal to francs 11·70; the countervailing duty on them is francs 6·45. The import duty on impure sugars is 5 pesos 70 centavos; hence the countervailing duty amounts to francs 5·98.

Costa Rica.—The countervailing duty on crystallized sugar is francs 20·50 per 100 kilograms; for refined sugar francs 15·00; for raw sugars, francs 15·25.

Argentine Republic.—The committee did not receive any information as to the recent sugar legislation of this country, and in the absence of any definite data it was decided to retain until further notice the present countervailing duty of francs 50·00 per 100 kilograms.

Dominican Republic.—In the absence of any definite information the committee retained the countervailing duty fixed on Argentine sugars, viz., francs 50·00 per 100 kilograms.

(2) The committee did not come to any definite conclusion in regard to the following countries:—

Bulgaria.—The bureau was requested to gather accurate information regarding the bounties granted to sugar beet growers. But the question was not considered very pressing, since Bulgaria does not export any sugar.

The Philippine Islands.—The committee was unable to obtain any information regarding the taxation of the domestic sugar production, and did not come to any decision for this reason.

The United States of America.—The bureau had not received any information on the domestic taxation of sugar since October 21st, 1903, and did not come to any definite decision for this reason.

Brazil.—The bureau had suggested the following countervailing duties:—For raw sugar, francs 6·45; for candy, francs 6·00; for other refined sugars, francs 9·00. But as the Brazilian Government had not communicated to the bureau any information concerning the domestic sugar legislation, the committee decided to leave it to the individual States adhering to the Convention whether they wanted to impose any countervailing duty on Brazilian sugar or not. This question has a practical significance, since Great Britain received 78,761 cwts. of sugar in 1903.

Cuba.—The committee suggested that the following countervailing duties be imposed:—For raw sugar, francs 5·86; for refined sugars, francs 11·38 per 100 kilograms. The British delegate objected on the ground that Cuba consumed barely 50,000 tons of sugar out of a total production of 1,000,000 tons, and that it imported practically no sugar for domestic use. Great Britain had received 440,682 cwts. of Cuban sugar in 1903. The decision of this question was deferred to a later meeting.

Mexico.—The committee was informed that Mexico was willing to adjust its domestic sugar legislation to the conditions of the Brussels Convention. No definite decision was arrived at. Great Britain received 159,608 cwts. of Mexican sugar in 1903.

Venezuela and Uruguay.—Although these countries export practically no sugar, the committee decided to defer decision until after the domestic sugar legislation of these countries had been made known. Great Britain received 10,341 cwts. of sugar from Uruguay in 1903. but the origin of this sugar was not quite certain.

(3) The committee decided that there was no basis for any countervailing duties against the following countries because they either do not export any sugar or because their surtax is lower than that imposed by the Convention:—

Turkey.—The duties amount to about francs 1·84 for raw sugar and francs 2·40 for refined sugar per 100 kilograms.

Persia.—The surtax amount to francs 1·62 for raw sugar and francs 2·42 for refined.

China.—Domestic duties are franc 1.00 for sugar above No. 10 Dutch standard, francs 1·75 for candy and francs 1·40 for refined.

Corea.—No sugar production.

Morocco.—No sugar production.

Congo Free State.—No sugar production.

Servia, Norway, San Salvador, and Danish West Indies.—No sugar production.—(*Beet Sugar Gazette.*)

SCIENCE IN SUGAR PRODUCTION.

By T. H. P. Heriot, F.C.S.

(Concluded from page 572, Vol. VI.)

7. Summary and Conclusion.

"Scientific thought is not an accompaniment or condition of human progress, but human progress itself."

Whereas all definite knowledge may claim to be scientific, the means of gaining such knowledge differs widely. If common experience be represented by the uncertain progress of a man groping his way in the dark, science provides him with a torch and a definite path to follow. Theory can, at best, serve as the torch, but scientific progress lies along the path of experiment and observation.

The acquisition of knowledge may therefore be either accidental or methodical, the essential characteristic of all science being its method of dealing with facts rather than in the nature of the facts themselves. The experimental methods of science possess this peculiarity, that the objects of study can be isolated, and, if necessary, observed under conditions which never occur in nature. If these methods appear indirect, complicated, and costly, this is due to the imperfection of our unaided senses, and also to the numerous and highly complex conditions which have to be studied separately before their joint effects can be rightly understood.

The applications of science to commercial interests is a comparatively modern development of what was formerly a purely intellectual pursuit. No longer confined to the laboratory and lecture room, science is to-day penetrating the workshop, the factory, and the field, with results which are aptly expressed by Clifford in the words quoted above.

Having shown what progress has been made in the ancient art of sugar production, it only remains to extract and concentrate the substance of our inquiry so that any lesson it contains may crystallise out. With this object, let us glance over the ground we have covered.

The Beet.	The Cane.
The sugar beet is an abnormal product of scientific research, differing remarkably from the forage beet from which it was derived.	The sugar cane is a normal vegetable, differing only from the wild cane in possessing greater vegetative vigour due to long cultivation.
The composition of the beet was first studied by Achard in 1747, and chemical analysis of various species of beets were made before 1800.	The first reliable analyses of the cane were made in 1883.

Scientific methods of field culture have increased the quantity of sugar in the root three-fold, and proportionally reduced the saline impurities.

The improved (abnormal) qualities of the sugar beet were fixed in successive generations of the plant by chemical selection of the seed-producers.

New varieties of the sugar beet, acclimatised to specific conditions, have been evolved by systematic chemical selection of the seed-producers.

Agricultural implements are extensively used in the various field operations. Considerable progress has been made towards designing a mechanical beet harvester which, when perfected, will materially reduce the cost of production.

The beet fabricant buys his roots at a price based on chemical analysis, thus forcing the cultivator to pay attention to the quality of his crop.

The earliest methods of manufacture were borrowed from the long established cane industry, but were eventually superseded by improved methods specially applicable to the beet, of which the two following are the most important.

No attempts were made to improve the saccharine richness of the cane until 1888. (See below.)

Chemical selection of cuttings for planting has never been attempted in practice. Small scale experiments indicate that any abnormal richness of the parent cane is not transmitted to the offspring raised from cuttings.

Natural causes have given rise to well marked varieties of cane, which were imported and first systematically studied in 1888, the imported cane generally proving inferior to the staple varieties. In the same year, the fertility of the cane seed was first recognized, and the highly variable nature of the seedling cane has since opened up a line of research which has been actively pursued to the present day. Practical experiments on the estates were commenced in 1900, and are still in progress.

With rare exceptions, the planter is dependent on manual labour, generally imported at enormous cost, and rendered necessary by the present method of harvesting the crop. No attempts have been made to design a cane harvester, as in other cane growing countries. The existing system of open drainage presents certain obstacles to the general use of field implements.

Where cane farming has developed, the canes are bought by weight at the factories, their saccharine richness being unknown.

The methods of manufacture have not been materially modified since sugar was first made in the West Indies.

The diffusion process extracts 97% of the sugar present in the sliced roots, and has the additional advantage that certain soluble impurities are not extracted, but remain in the exhausted slices.

The main improvement in the cane mill may be traced to the earliest methods of beet extraction. Thus double and triple crushing, combined with maceration have increased the extraction from 75% to about 92%.

The carbonatation process of purifying the juice has been brought to a high degree of perfection by the combined influence of chemical research and the invention of the filter-press.

The primitive chemical treatment of the juice with lime remains practically unchanged. Its chief recommendation being simplicity and cheapness.

Multiple-effect evaporation was designed for treating beet juice, but was first operated with cane juice in Lousiana.—The vacuum pan and the sugar centrifugal were borrowed from the British refinery.—Appliances for crystallisation in motion originated in the beet industry.

These improvements were subsequently introduced into West Indian factories.

The beet sucrerie is controlled by resident professional men, including an engineer and a staff of chemists with trained assistants. The chemical laboratory constitutes the head office of the sucrerie.

The large majority of cane factories are under the direct control of the planter, or manager of the estate, chemical control of the manufacture has never been seriously attempted, there being not more than one chemist on any estate.

In no single instance has the cane industry taken the lead, its progress being due to three external sources :—

1. Methods and appliances borrowed from the beet industry.
2. The general advance in engineering science as applied to the designing and construction of sugar machinery, improvements in which are due to the designer.
3. The gratuitous scientific work of Government chemists and botanists.

Although progress may be made by *adopting* methods and appliances, the proof of technical efficiency lies in the power to *originate*. We would, therefore, direct the reader's attention to those dissimilarities in the rival industries which have given rise to progress along divergent lines.

The nature of the raw material enters into two fundamental problems of sugar production, namely, that of increasing the saccharine value of the raw material, and of extracting the juice. Have either of these problems been satisfactorily solved? At the risk of some repetition let us briefly refer to facts.

Starting with the forage beet, containing some 6% of sugar and an abundance of saline impurities, Vilmorin evolved a new variety containing as much as 20% of sugar and a reduced proportion of impurities.

Only 15 years ago a Government botanist informed the West Indian planter that the sugar cane can be raised from seed, and that the seedling cane might furnish him with an improved stock. Experiments, with seedling canes, now in progress, indicate that an improved variety of cane may yet be found although it is true that the ideal has not yet been realised. We thus learn that whereas the beet industry only came into existence after the saccharine character of the forage beet had been improved, similar attempts to improve the sugar cane have been delayed by a strange oversight on the part of the planter.

Turning to the second problem, we find that many methods of extracting beet juice were tried before the diffusion battery took a practical shape. Diffusion may fairly claim to be an ideal process for two reasons,—first, it is possible to extract 99·9% of the sugar contained in the sliced roots (although other considerations render it more profitable to limit the extraction to 97%); and, secondly, diffusion extracts sugar in preference to certain impurities, and, therefore, furnishes the fabricant with a juice of higher purity than that actually present in his raw material.

As distinct from the beet, the fibrous part of the cane is of great value as fuel, so that in selecting an economical method of extraction, the fuel-value of this by-product is an important consideration. As the cane mill has held its own, even against the diffusion process, since the first primitive mill was constructed by the Chinese, we should expect to find that this method of extraction is as ideal for the cane as diffusion is for the beet, but recent progress has gone far towards proving the contrary, and, in a few months, a new process will make its *début* in the West Indies, We here refer to the Hinton-Naudet process which has been successfully applied to the cane in Madeira, and which, from our present point of view, performs that operation which has hitherto been imperfectly effected by the mill. Once more will the West Indian sugar producer learn from his beet rival, even in solving a problem peculiar to the cane industry.

If the nature of the sugar cane, as a raw material, presents no serious obstacles to the progress of this industry, the fact that improvements have been forced upon the cane planter by stress of competition, is not very much to his credit but rather implies a lack of initiative and technical ability..

Whilst every credit is due to the planters for their untiring efforts to hold their own against their more scientific and state-aided competitors, we cannot ignore the fact that the technical and financial success of this or any other industry is mainly dependent on the

selection of qualified workers. As regards the West Indies, too much reliance has been placed on up-to-date machinery and too little effort made to secure the services of up-to-date men. The efficient control of a sugar estate calls for more technical knowledge than can be acquired by such routine experience as that of an overseer before he holds the position of manager. Although destined in the future to become active leaders of the industry, how many overseers have sufficient ambition to study the scientific principles which underly their daily practice? Little wonder then that the planters are unwilling to depart from the old-time methods which, in many cases, constitute their only technical training.

But, further, we have shown that every advance in the technology of sugar production demands an increasing scientific knowledge on the part of all those engaged in the industry from the manager down to the factory-hand. The value of improved machinery consists in its capacity of doing a certain maximum of work when intelligently handled, but, if the intelligence is lacking, the best machinery may prove but a poor investment. Similarly, a new and valuable process may easily fail through the ignorance or shortsightedness of those who wish to adopt it.

If the cane industry is to be placed on a sound footing, ignorance must be replaced by knowledge. It is interesting to recall the early days of the beet industry in France, when "Napoleon issued a decree, dated 15th January, 1812, that five out of the 40 factories existing at that time should be made schools for sugar-making and chemistry. Over 150 students were sent to the schools, and the best teachers were attached to the factories. Each student had to be three months in the factory and, if he passed the necessary examination, he received, on leaving, £40 in money and a certificate as a qualified beet sugar manufacturer. To encourage the erection of factories, licenses were issued to persons willing to devote their attention to this industry for four years, an extension of these licenses being granted to those persons who made improvements."*

Our inquiry has been specially directed to the relative progress of the cane and beet industries, and their rivalry regarded from a technical and historical point of view, but we must not ignore the fact that the vast extension of the beet industry has only been rendered possible by fiscal conditions, which have but lately been abolished. Notwithstanding all that science has done for that industry, the cost of producing beet sugar remains considerably higher than that of cane, and it is this fact which constitutes the vital difference between the two industries, and which is bound to have far-reaching effects in the future history of sugar production.

Let it be noted, however, that the lower cost of production of cane sugar is due to the nature of the sugar cane as a raw material *par*

* Stein.

excellence, and is in no way traceable to the superior efficiency or to more economical methods of working in the latter industry. On the contrary, the reduction in the cost of production of beet sugar has far surpassed that of the cane within the same period of time, and we have clearly shown that the main economics practised in the modern cane industry were borrowed from that of the beet.

With a future price of sugar regulated by the law of supply and demand, and thus eventually excluding the more costly beet sugar from the world's markets, it is pertinent to inquire how the West Indian industry may expect to prosper in competition with other cane-growing countries? Now, although cost of production is largely regulated by local conditions, such as cost of labour, fertility of soil, climate, &c., there can be no doubt whatever that sugar could be produced all over the West Indies at a much lower cost than that obtaining on 99 % of the estates now in cultivation. Leaving out of consideration the increased yields per acre, which would result from mechanical tillage and improved methods of cultivation, the fact remains that only about 14 % of the total number of estates have adopted modern methods of manufacture.

But of the so-called modern factories, numbering about 140, how many can claim to use the most improved machinery? Up to the present day only one factory has so far attempted to extract a maximum yield of juice from its cane by means of the modern nine-roller mill, which is extensively used in other cane-growing countries.

Facts like these cannot be ignored if the cane industry of the West Indies is to survive future competition. A desire to see this industry progressive and prosperous must be our apology for drawing attention to its defects.

GENERAL SYNDICATE OF SUGAR MANUFACTURERS OF JAVA (DUTCH EAST INDIES).

Prize Competition.

The General Syndicate of Sugar Manufacturers offers the following prizes to the "Inventors of a Practical Automatic Self-registering Sugar Juice Weighing Machine":—

	Florins.
First prize	2000
Second ,, ...	1000
Third ,, ...	500

The directors of the General Syndicate reserve to themselves the right to refuse to grant a prize if none of the apparatus submitted for examination should be of practical value.

Notes and further Conditions.

The machines must be at the disposal of the members of a commission to be appointed by the Syndicate, for a period not exceeding six months.

All machines, including those which receive the award, remain in the possession of the competitors.

All freights to and from the place of examination (in Java) will have to be paid by the competitors; the cost of placing and examination, however, will be undertaken by the Syndicate. The machines must satisfy all the following conditions:—

(*a*) A quantity of 1000 kg. juice at least should be weighed at once.

(*b*) Errors of indication should not exceed 0·1%.

(*c*) Accurate working, even after a long use in a factory mill.

(*d*) They must be capable of weighing half filtered juice.

(*e*) Acid juices must have no influence on the material of construction.

The machines can be sent in from 1st May until 31st July, 1905. The awards will be distributed not later than 31st December, 1905.

For further information apply to the Chief Secretary, Sugar Manufacturers' Syndicate, Pekalongan, Java.

JAMAICA.

The injury caused by the storm of August 11th, 1903, to the industry here was comparatively small owing to the fact that the main sugar districts were out of the area visited by the storm, but this year's crop has nevertheless suffered much from drought, and a shrinkage has to be recorded in the year's transactions. This is unfortunate, especially when it is remembered what a struggling industry this has been, but much is hoped from the abolition of the bounties in restoring its value, as it is an industry that once placed Jamaica on the list of wealthy places. Possessing a soil suitable for the growing of the sugar cane, Jamaica should be able to hold her own in the sugar markets of the world. The old troublesome problem of sufficient labour is one, however, still to be solved. Possibly the difficulty will be overcome in the near future by the peasantry taking seriously to cane farming, and in this connection it may be interesting to note that in Westmoreland the peasantry are planting canes for the purpose of supplying estates wherever land is available, and the canes so grown find a ready sale at 8s. per ton. One estate bought during the year 2400 tons of small settlers' canes, while in another instance 50 tons were purchased. There is also promise in Saint Elizabeth and Clarendon of an increasing trade between peasant cane farmer and estate.

The question of finding new markets for our sugar is also one that must be faced sooner or later, in view of the reciprocity treaty recently

entered into between the United States of America and Cuba. Canada offers special advantages to British cane sugar entering the Canadian markets; a preference of about £1 a ton is allowed by that country on British cane sugar. To secure this advantage the sugar planters would, however, be required to make such arrangements in obtaining a direct entrance into the market as would prevent the Canadian refiners from uniting to secure the preference to themselves.

Never have the prospects of the sugar planters of Jamaica been so bright since the days of slavery, when labour was free. The results of the Brussels Convention gave sugar plantations a decided impetus in Jamaica, and now it is expected that with the high price to which sugar has attained planters will increase their area of cultivation and adopt modern machinery. Some of the estates have already given orders for the latter, and at Denbigh, in St. Catherine, the installation of modern machinery in the place of the old type of Jamaica copper wall is nearly completed. At Caymanas also the mill is to be altered to a five-roll mill, with improved crushing efficiency and yield of juice.

The coming crop, for which planters are preparing, promises to be an excellent one.

The following notice appeared in the *Jamaica Gazette* of the 1st inst.:—"Under the power given by section 1 of the Jamaica Rum Protection Law, 26 of 1904, the Governor has appointed J. C. Nolan, Esq., to be the person who, under that section, is empowered to institute proceedings and undertake the prosecution in the United Kingdom of Great Britain and Ireland and elsewhere, of offences under the Merchandise Marks Acts, 1887 and 1891, of the Imperial Parliament (50 and 51 Vic., chap. xxviii., and 54 Vic., chap. xv.), so far as such acts apply to Jamaica rum, and to take all other necessary and proper steps and proceedings for protecting Jamaica rums from imitations and frauds."

The meaning of this notice is clear enough, and, in view of the recent Stockport case, highly necessary. Mr. Nolan's salary will, it is understood, be £250, and £200 travelling expenses.

In connection with this, the *Jamaica Daily Gleaner*, in an interview with Mr. Nolan, says:—"According to a statement just made, in June last 3000 puncheons of Demerara rum were sold in England at 7d. a gallon. It is calculated that packing, carriage, &c., cost fully 5d., so that only 2d. was left as the value of the rum. It is stated also that Demerara rum is never sold for more than 15s. a puncheon. It is claimed that the rum that is sold so cheaply is retailed in and exported from England as Jamaica rum, which commands a higher price. Consequently in fighting for the protection of Jamaica rum it becomes necessary to establish certain important differences between the Jamaica and Demerara rums."

It is understood that an attempt is about to be made to get Demerara rum imported into England as methylated spirits. If this were done, the protection of Jamaica rum would be rendered comparatively easy, for then there would be no occasion to fight the Demerara commodity.

Mr. Nolan has secured an analysis in England, which shows:—

	Jamaica.	Demerara.
Absolute alcohol by weight, per cent.	72·24	69·63
Absolute alcohol by volume	77·12	76·57
Proof spirit	135·14	134·19
Extractives	0·07	0·33
Acids as acetic acid	65·37	100·30
Aldehydes	68·46	84·62
Fin. final	2·48	2·43
Ethers as ethyl acetate	280·00	106·91
Higher alcohols	108·40	163·17

The markets to which our sugars were sent, and the quantities placed in each of them during last year, were as follows:—

	Cwt.
United Kingdom	60,066
United States	88,844
Canada	108,425
Foreign States	9,038
British West Indies	4,131
Bermuda	10
Russia	3
British Guiana	1
Foreign West Indies	2

PLANTATION CARACAS, CUBA.

The Caracas plantation is one of the largest in the island of Cuba, and the most important in that part of the island. It is only exceeded in value by some of the new American properties, such as Chaparra on the eastern side. Caracas comprises 3,200 hectares planted in cane, and is divided into a certain number of settlements which are connected with the railway of the estate. It is owned by MM. Emilio and Francisco Terry, and is situated 30 kilometres to the north of the town of Cienfuegos, between the stations of Cruces and Lajas. It is connected to the main line passing these stations, and is the centre of an important junction, extending over 101 kilometres, which unites the settlements to the sucrerie, and also communicates with a river by a branch line of 30 kilometres, where the sugar is embarked in lighters. A tug conveys the lighters to the Gulf of Cienfuegos, where the sugar is transhipped into steamers. To avoid the cost of transhipment a line is proposed to take the sugar direct from the usine to the ships. This railway would also transport the sugar of a neighbouring estate.

The usine has been recently erected, dating actually from 1889, when there was only a beam engine and one mill in the sucrerie of Tomas Terry. The present building was erected by the Fives-Lille Company, and consists of five parallel bays of 16, 12, and 18 metres span, and is 120 metres in length. Including the building for the second series of mills, the actual surface covered exceeds one hectare. The usine is equipped with two milling plants, one in the principal building, and the other in a separate building, having also its steam plant. These two sets of mills can therefore work together or separately, according to the supply of cane, the juice from both plants being united in the factory.

The usine crushes an average of 2,200 tons of cane in 24 hours, the canes being transported by a rolling stock, comprising eight locomotives, 360 bogie trucks, carrying from eight to nine tons of cane, and also four-wheel trucks, carrying 2·5 tons, and which are only used on the portable railway, but can be brought to the usine on the permanent line. The cane is transported in bogie trucks, and the sugar in covered trucks. The rolling stock also comprises three trolleys, one for the use of the proprietors and the staff. There is a regular service of passenger trains between Cruces, and the sucrerie at Lajas, these two localities being two consecutive stations on the main line from Havana to Cienfuegos.

The cane trucks are weighed, several at a time, on two scales enclosed in a large building. They are then drawn on to side lines by animals, and brought underneath two mechanical hoists or beams, which can be raised and lowered, or moved laterally. Four chains, terminating in hooks, are suspended from each beam, two at each extremity, and two in the middle. The beam is brought parallel to the axis of a truck of cane, and the four chains are passed underneath, the load and each hook is then linked into its chain, which thus encloses a large mass of cane, representing half of the load of the truck, and weighing from four to five tons. A mechanic then sets a steam winch in motion, when the beam rises, the chains become taut, and the load is elevated and brought over a large dumping board, whence an elevator conveys it to the mills. The large trucks are thus discharged in two operations, the smaller trucks in one; a partition in the larger trucks separates the two loads of canes. This hoisting appliance requires only four men, and operates almost automatically.

Extraction of the Juice.—Each hoist feeds one set of mills. The older milling plant comprises a Krajewski and Pesant crusher, driven by a horizontal engine. The rollers are 1·67 metres long; the engine is about 75 horse power, the diameter of cylinder being 457 m.m. and 762 m.m. stroke. The cane passes immediately through three mills, having rollers of from 2 to 1·67 metres in length, each driven by a beam engine. But these four appliances

are to be replaced in the campaign for 1904–5 by the following:—A new crusher of the same type, but of two metres length, and two mills also new, having rollers 2·13 metres long and 865 m.m. diameter, driven by a single horizontal engine with cylinder 760 m.m. diameter and 1·52 metres stroke, with hydraulic pressure on the top rollers. The strongest of the three older mills will serve for the first mill of the new arrangement.

The second group of mills, which are in a separate building, include: a Krajewski and Pesant crusher, with double gearing, driven by a horizontal Corliss engine of about 90 h.p., with cylinder 460 mm. diameter, and 920 mm. stroke. Then comes a mill with double gearing, rollers 2·13 metres long and 865 mm. diameter, with hydraulic pressure (220 kilogrammes per square centimetre) on the top roller. It is driven by a Corliss engine, constructed by Farrell, Ansonia, U.S.A. It is followed by another mill (2·13 m. × 920 mm.) with double gearing, made by Fletcher, of Derby, and driven by a horizontal engine. Hot maceration water is added between the first and second and between the second and third mills.

The juice from the mills passes through gutters into underground receiving tanks, one for each milling plant. These tanks are covered with strainers of fine copper gauze which retain the fine megass and small particles of cane. A small elevator with paddles fitted with rubber, scrapes the surface of the strainer and elevates the solid matter to one of the mills. The juice is drawn from the receiving tanks by direct-acting Worthington pumps, and is elevated to the defecators after traversing a horizontal tubular heater which raises the temperature 40 or 50 degrees. There are 16 defecators of 50 hectolitres capacity, provided with double bottoms for heating with direct steam. The juice is rendered slightly alkaline with milk of lime, with which it is intimately mixed by means of an attached Lacouture mixer, and then heated.

The impurities gradually rise to the surface, forming a blanket, and the steam is shut off at the moment that ebullition commences. The defecator is then left undisturbed for as long a time as possible, after which the juice is decanted. The first few litres (coming from the bottom) are sent to the scum tank, as also is the last portion which contains the floating matters. The clear juice is conveyed to the evaporators by means of a pump driven off one of the triple-effet engines.

There are ten square scum tanks, furnished with heating coils and cocks at different heights. The scums are always kept hot while the tank is filling, and the clear juice is decanted through the different cocks, the residue being sent to the filter presses.

The scums are removed from these tanks by a Worthington pump, which conveys them to the scum receivers situated over the filter presses in a separate building. There are four monster filter presses,

with plates measuring one metre on each side. The scum cakes are not washed, and are discharged direct into trucks, and dumped in great heaps in the field. The filtered juice is removed by a pump and sent to the receiver for defecated juice. In the same building, there is also an engine which drives two machines for washing the filter cloths.

Evaporation. — This department comprises three triple-effets mounted on a metal platform on the first story, having their nine bodies in line and their several air pumps below but a little in advance, as is usual in French sucreries. Starting from the left, there is first a Fives-Lille triple-effet, of 5,000 hectolitres capacity; then in the middle an American triple-effet of Colwell's, of about 2,500 hectolitres capacity; finally, on the right, there is a Cail triple-effet (1890) having 825 square metres of heating surface, and treating about 5,500 hectolitres of juice, and having three inlets for steam on each body. Under the latter apparatus there is a pump of the ordinary type but used as a dry pump in conjunction with a barometric condenser. This engine also drives the juice pump, the syrup pump, and a large pump for injection water, by means of suitable gearing.

The American triple-effet is connected with a wet air pump made by the Fives-Lille Company, as also is the same firm's triple effet. The diameter of the steam cylinder is 510 mm., and that of the water cylinder 900 mm., stroke 900 mm.

Vacuum Pan Plant.—There are two pans for first sugar and one for seconds. The two former, made by Cail, are 3·75 m. in diameter, with a capacity of 350 hectolitres, and are fitted with eight coils. The third pan is from the Fives-Lille Company, of the same diameter and capacity, but fitted with five coils. A fourth Cail pan, with tubular heating surface, and 3·25 m. diameter, is used only for low-grade products. These pans are arranged in line on a platform which is 3·50 m. above that of the evaporating plant, and to the left of the latter. The Fives-Lille pan is connected with an ordinary air pump, with steam cylinder 420/800 mm. and water cylinder 750 mm. diameter. The two Cail pans are connected to a barometric condenser. The wet air pump operates like that of the Cail triple-effet and comprises two double-acting pumps worked at half speed. For the present campaign, it is proposed to erect an American pan purchased from a neighbouring factory.

The condensing water from all these pans is removed by the following pumps: a direct-acting duplex pump, having two steam cylinders 650 mm. diameter and 915 mm. stroke, and water cylinders 610 mm. diameter; a Blake of the same type, with steam cylinder 405 mm. diameter; a Worthington, also of the same type, with steam cylinder 460 mm. diameter, and 460 mm. stroke water cylinder 560 mm. diameter, and which serves as a spare; and two centrifugal

pumps, driven by a beam engine, and working intermittently according to the quantity of water to be raised.

These pumps elevate the hot water to a tank, of 100 hectolitres capacity, which is raised 20 m. above the ground level, whence the water gravitates to a refrigerator on the jet principle. The latter consists of a cement platform, 80 × 20 m., raised 8 m. above the ground, and traversed by eight horizontal and parallel pipes fitted with jets at distances of 3 metres which throw the water to a height of 2 to 2·50 m. in a very finely divided state. The cooled water from the refrigerator enters a basin, and is drawn back to the injectors by cold-water pumps. The temperature of the air is 30°C., that of the hot water is 47°C., and the cold water 34°C.

A Fives-Lille pump and a direct-acting pump are alternately employed to elevate the cold water to a tank of 100 hectolitres capacity, mounted on a metal framework at a height of 20 m. above the ground level. Water is also supplied from a weir, situated four kilometres from the usine, by the pumping station used in the irrigation.

Returning to the factory below the pans, and on a level with the triple-effets, there is a staging divided into two parallel tracks supporting from 700 to 800 conical boxes on wheels, each of which holds from 650 to 700 litres of masse-cuite. A gang of men are employed in bringing the empty boxes under the pans, filling and removing them to the more distant part of the track, where they are left for 24 to 36 hours in order that the masse-cuite may cool. The boxes are then brought on to a tipping winch and inverted over a pug-mill, whence the masse-cuite flows into a large mixer from which the centrifugals are suspended in groups of four and six.

When the masse-cuite is dry and cold it often falls from the box in a single block, without requiring the usual application of compressed air. There are 31 centrifugals arranged in line on the ground level, which are of the Hepworth and Weston suspended type with bottom discharge. The masse-cuite is cured dry, without the use of steam or water, and yields a first jet of 96 to 97 % for the American market. Twelve of these machines are used for both first and second jet sugars. The cured sugar gravitates into one of four chambers, whence bucket elevators remove it to four hoppers, from which it is bagged off; there is consequently no handling of the sugar.

The second-jet masse-cuite is cooled in ten open mixers, of 200 hectolitres capacity, furnished with water-jackets. Five were supplied by the Fives-Lille Company and five were made in the country from the same model. These mixers are on the ground level, and after from two to four days the masse-cuite is elevated to the mixers over the centrifugals by means of a pump. The number of centrifugals will be increased by this campaign. The 31 machines and ten mixers are driven by three horizontal engines, supplied by

the Cail and Fives-Lille firms. The molasses are elevated by a Worthington pump. The first molasses are brought to the boiling point, and skimmed in tanks heated by steam coils. The final molasses are exported, although the usine had a complete distillery plant.

Steam Raising Plant.—There are two systems of boilers; that erected in the usine is of the Babcock & Wilcox type, working at a pressure of from five to six kilograms. Only megass is used as fuel which is fed mechanically to furnaces of the Cook type, communicating with a brick chimney 50 m. in height, and working under forced draught. These boilers are fed by two pumps. The megass conveyor consists of two endless Ewart chains, with wooden paddles, travelling over a fixed wooden bed, and driven by five vertical engines. The megass is pushed forward by the paddles and falls through apertures in the bed of the conveyor, the return strand being supported on toothed wheels at some distances apart; an arrangement which is simple and economical.

The smaller, or second mill-house has also a boiler range, consisting of four "porcupine" boilers. This type of boiler, which is much used in the United States, consists of a vertical sheet-iron cylinder with short radiating tubes projecting from the surface of the cylinder and closed at their exterior ends. A plan of this boiler resembles that of a carriage wheel without the rim and therefore justifies its peculiar name. Each boiler is enclosed by an outer casing of fire-brick, the lower part of which communicates with two megass furnaces by means of flues whilst the upper part of each casing terminates in a sheet-iron chimney. This installation is completed by a Fives-Lille feed pump, one spare pump, two centrifugal blast-fans with vertical engines, and one engine for the megass elevator.

The usine is equipped with an electric light plant, from which the private residence of M. M. Terry is also lighted. This comprises a Gramme dynamo driven by a Lecouteux & Garnier engine, of about 100 h.p., and supplies the current for arc and incandescent lamps. There is also another dynamo driven by an American horizontal engine of about 20 h.p., but this is shortly to be modified.

The usine possesses a well stocked workshop alongside of the mills, with its own engine and furnace. A separate building forms a very complete carpenter's shop, with circular and other saws, &c., driven by a Fives-Lille engine and boiler fed with the waste wood. The woodwork of the trucks requires constant attention, especially in a hot and moist climate; tho wood employed being pitch pine. There is a laboratory, but this was closed.

There is telephonic communication between the traffic office of the usine and the various settlements; also with the town of Cienfuegos and tbe shipping wharf on the Rio-Salado, which are respectively 33 and 30 kilometres distant.

The crop season commences early in December, before the canes are fully ripe, and lasts until the end of May or the beginning of June; being brought to a close either on account of the cost of transport from outlying districts, or by the rains which are then due and which render cane-cutting and carting almost impossible.

A circular diffusion battery (18 diffusers of 65 hectolitres capacity) was erected by the Fives-Lille Company in 1889, but only operated occasionally, the usine not then having been provided with sufficient evaporating power to deal economically with the additional water required for diffusion, nor with suitable appliances for drying the cane chips for use as fuel. This installation was completed by three slicing machines, 2·50 m. diameter; an air-compressor; an engine driving two bucket elevators, one for the fresh, and the other for the exhausted chips; a water pump; two measuring tanks; and a tubular re-heater for the water used in the battery. Another diffusion plant, similar to the above, has not yet been erected. Twelve Danek filter-presses are also awaiting erection on the ground floor of the usine.

An administrator is in charge of the plantation, the factory being under the control of an engineer and the sugar manufacturer, who receive so much per bag of sugar produced after deducting the salaries of the pan-boilers, overseers, and defecation hands; the curing being paid by the task. There thus results a great simplification in the administration, but as the work is under no control, everything is done by blind routine, no one having any interest in obtaining a maximum yield of sugar as first jet. There are enormous losses in the extraction, only 70% of juice being obtained from the cane; very little maceration water can be used without running short of megass for the furnaces, there being a great waste of steam. Thus, for example, there are no less than 66 steam cylinders in the usine, necessitating a very considerable length of steam piping. Besides being too numerous, most of these engines are direct acting pumps, in which steam is admitted to the cylinder during the complete stroke of the piston. Only the centrifugals are belt-driven.

The exterior of the usine has an imposing appearance, all the buildings being of iron and supported on iron columns. A clock on a central tower actuates a number of dials in the usine. The sides of the buildings are open, according to the Cuban custom. In the centre of the façade there is a brick building comprising a small store room, an office for the head engineer, and three upstair rooms forming the laboratory. Numerous buildings are grouped around the usine: carpenters' shops, a locomotive depot, weighing offices, an hotel, molasses cisterns, barracks for the workmen, supply stores. The proprietor's residence is in the centre of a park adjoining the usine. All these buildings are close to the railway, which in some places has a third rail corresponding to the gauge of the main line to

Cienfuegos. The place is busy with traffic, trains of canes arriving day and night.

At 6 p.m. the usine stops for 1½ to 2 hours to clear the furnaces rom the slag which has accumulated during the preceding twenty-wo hours. At the same time, the mills are washed down, and any small repairs attended to. The triple effets are cleaned with acid once a week, whilst the copper bottoms of a certain number of defecators are cleaned with acid every day.

During the first four months of the campaign 1903-4, which commenced December 2nd, the usine worked up 204,120 tons of cane, containing an average sugar content of 14·85, coefficient of purity 86. The mixed juices from the mills gave:—Brix 19·1, Sugar 15·93%, Purity 84, Extraction (including maceration water) 75·5. The megass contained 9·6% sugar. There were obtained 193,450 hectolitres of first masse-cuite, representing 14·25% on weight of canes, and containing:—Sugar 82·2%, Purity 88, Density 1·51. The yield of second masse-cuite was 71,050 hectolitres, with Density 1·43, Sugar 59·3%. The final molasses had a Density 1·39, and contained 46·5% Sugar.

Return in raw sugar of first jet	= 9·10	10·80
,, ,, ,, second ,,	= 1·70	
,, pure sucrose, first ,,	= 8·78	10·24
,, ,, ,, second ,,	= 1·46	
Sugar lost in the megass	= 2·79	
,, ,, molasses	= 1·23	
,, ,, scums	= 0·11	
Undetermined losses	= 0·48	
Total losses	4·61	
Pure sucrose recovered ..	10·24	
Sugar in the cane	14·85	

After the month of February, the cane contained from 15 to 16·5 % of sugar, with juice of from 20 to 21 Brix., and Purity from 88 to 91.

The first-jet sugar polarised from 96 to 97, the second-jet from 85 to 88. Since February, the first masse-cuite was mixed with 6,150 hectolitres of molasses, of 1·32 Density, and containing 56% of sugar. Up to the 31st March there were bagged off 122,630 bags of first sugar weighing 149·5 kilograms, and 21,570 bags of second sugar, giving a total of 144,200 bags. The total output of the campaign should reach 200,000 bags, corresponding to 300,000 bags of 100 kilos each. —(*Journal des Fabricants de Sucre.*)

PALMYRA SUGAR MANUFACTURE.

By far the largest portion of refined sugar manufactured in the Madras Presidency is manufactured from the juice of the palm which grows so abundantly in the southern parts of the Presidency. On the juice being collected from the trees, it is boiled in vessels over a fire, and made into "jaggery" by a process similar to that used in the case of the sugar cane, and this jaggery is then put into gunny bags and dispatched by road, by rail, or by steamer, presumably to the nearest refinery from which it eventually issues as refined sugar, the degree of whiteness and quality, and perhaps quantity also, to some extent depending on the plant, the methods employed, and the experience of the refiners.

From the time the jaggery is manufactured on the spot until its arrival at the refinery, there is often great delay, during which it is gradually undergoing inversion, or conversion, into grape sugar, *i.e.*, sugar which cannot be crystallised or—molasses. On arriving at the refinery it is stored for a further period until it can be worked up, and during this time further deterioration and conversion into molasses takes place, and when the inversion occurring during the first boiling of the juice to jaggery owing to the use of unsuitable vessels, is taken into account, it will be readily understood that the amount of crystallisable sugar remaining in the jaggery when it comes to be worked up is something less than it might have been under different conditions—say, perhaps 50 per cent. less. The wonder then is that the jaggery is used at all for refining, and probably it would not be if the great quantity of molasses produced was not utilized in the distillery for the manufacture of arrack.

In the refining of jaggery, the first step after extracting it from the gunny bags and breaking it up, is to put it into tanks or blow-ups, in which it is mixed with water, heated and stirred until all is dissolved and at a density suitable for its being filtered, and afterwards boiled in the vacuum pan. On account of the large quantity of deteriorated gluten and other foreign matter in the jaggery, it is necessary that the liquor be run through bag filters before it passes to the bone char filters for its discolourisation, which latter process necessitates an expensive plant, including char kilns for revivifying the char, kilns for the burning of the bones, and machinery for the disintegration of the burnt bone into a grain suitable for filtering purposes. The liquor on being discharged from the bone char filters may with advantage be sulphured, in order to obtain a whiter sugar than would otherwise be produced. The liquor is now ready for boiling to grain in the vacuum pan, after which operation it is discharged into cooling tanks or crystallizers, whence it goes to the centrifugals where the molasses is separated from the crystals.

Under existing conditions the manufacture can only entail to those engaged in it a continual struggle to make both ends meet, and it would not be surprising if the manufacturer gave his attention more to the distilling of the uncrystallisable portion of the jaggery leaving the refined sugar to come out as it liked.

The manufacture of sugar, whether raw or refined, whether from the sugar cane or from the palmyra tree, ought to be a thriving industry in India. Sugar is an article of universal consumption, and the enormous quantity of sweets consumed in one form or another by the Indian population is sufficient proof that the sugar production of India must be enormous. Yet we find that hundreds of thousands of tons are annually imported from other sugar-producing countries, although there is not another sugar-producing country in the world which is better suited to the sugar industry, or has such an abundant supply of cheap labour. What is the reason of this? It is that the manufacture of sugar in India is roughly and wastefully carried on, and until the very necessary improvements are made in the methods and machinery employed, Indian sugar will remain practically unknown and despised in the world's markets.

If instead of making the juice into jaggery when refined sugar is required, the juice as it is collected from the tree were directly manufactured into refined sugar, a considerable gain would be effected, as the expensive plant for the filtration and discolorisation of the liquor would not then be required, and there would be a minimum of inversion, the result being a considerable increase in the output of refined sugar from the same quantity of juice and at less cost.

The manufacture would be exactly the same as in the case of cane sugar, palmyra sugar having the advantage that a crushing plant is not required, and is as follows: The juice on being brought from the trees is clear, white and transparent, resembling the juice of the cocoanut. It is emptied from the chatties into tanks where it is limed to neutralise any acidity, sulphured and passed through bags or sand filters, from which it issues as clear juice ready for evaporation. On being evaporated by the most economical method, viz., multiple effect evaporation, the thick liquor is boiled to grain in the vacuum pan as already described. The molasses from the centrifugaled sugar are boiled up for second and third sugar, the final molasses being only of use for distillery purposes.

Another advantage in manufacturing the sugar direct from the juice is, that an enormous quantity of fresh water for the melting of the jaggery is not required but instead there is a large supply of hot water available, which has been evaporated from the juice, and which can be utilised for the boilers and other purposes. For condensation purposes the juice itself can be utilised to great advantage, thus also reducing the amount of cold water required.

The water-supply being one of the most important points, is often a source of anxiety during hot weather, but this question is solved by the digging of a well, as at Melrosapuram, and by erecting over it a "fascine," similar to what is used in Mauritius, through which all the hot water available trickles, and falls cooled into the well below from which the circulation goes on. In this case the well would only be for factory purposes, as irrigation is not required for the trees. The cost of its manufacture into jaggery, of its transport, and the required gunny bags, would be saved, and such a plant for the manufacture of refined sugar direct from the juice, even should it be on a small scale to turn out say, one ton per day, according to the number of palm trees on the estate, should be a very profitable concern to the wealthy native landowners or others who have the good fortune to possess them. If refined sugar is to be made for the market, why should it not be manufactured in a rational and profitable manner from the clear juice, instead of from the filthy mass at present made, to refine which necessitates the expenditure of the very profits that ought be realised for fuel, transport labour, and plant? If jaggery is to be made for the market why should it not also be made in an economical manner, and of a quality which it would pay to refine? The profitable manufacture of sugar in India is one of the industrial problems. The pity is that more attention is not given to the solution of such problems, which are easy enough to solve, and the results of which would be a benefit to the whole community.—*(Indian Agriculturist.)*

THE DIFFUSION OF MEGASS.

It is well known that "dry" double crushing fails to extract all the sugar contained in the cane. To improve the extraction attempts have been made to macerate the megass, as it leaves the first mill, with hot water, so that after the second crushing, the residual juice is diluted and, consequently, the sugar-content of that juice diminished. We shall presently show that this maceration is a very imperfect method; a fact which is, moreover, evident *a priori*.

Suppose, for example, that it is desired to reduce, by one-half, the sugar-content of the residual juice in single-crushed megass. It will be necessary to macerate this megass with a quantity of water equal in weight to the residual juice which it contains. Even assuming that the mixture of water and juice is perfect; in other words, that the water instantly penetrates the cellular masses of the megass at the moment of its addition, the maceration process still presents certain inconveniences which are only partly compensated by its advantages, since the gain in the sugar which results is at the cost of a very considerable dilution.

To solve this problem successfully without abandoning the principle it is necessary to change the method of operating, and

the "diffusion" of megass affords a very perfect method of maceration for the following reasons:—

1. The megass is brought into contact with a series of liquids of diminishing saccharine richness, in such a manner that, instead of the residual juice being diluted in a single operation, it is submitted to a graduated series of dilutions, which permits the extraction of juice from the megass to be carried much further with but a small addition of water.

2. The admixture of the residual juice with the surrounding liquids is rendered certain by a prolonged contact of the megass with these liquids, and by a suitable temperature.

We may here briefly refer to the direct diffusion of the cane, which gives equally good results from the point of view of extraction, but which necessitates the costly slicing of the cane into chips, the use of a large number of diffusers, and many operators, and which yields a more dilute juice than that obtained by the combination of dry crushing with diffusion of the megass; moreover, the fuel obtained by this process is difficult to re-crush, and is very inferior to the megass resulting from double-crushing.

We now proceed to give some figures extracted from the records of large usines where the diffusion of megass has been recently installed:—

The cane contained about 12·2% of sugar and 10·5% of fibre, and the method of extraction consisted in "dry" double-crushing of the cane, diffusion of the megass, and double-crushing of the exhausted megass in order to dry it for use as fuel.

The dry double-crushing yielded about 66 litres of juice per 100 kilos of cane. With maceration there was obtained, on the contrary, 85 to 87 litres of 1·053 density, containing about 68 litres of normal juice, and from 17 to 19 litres of added water.

In the diffusion of the megass, from 23 to 26 litres of juice were drawn off per 100 kilos of canes. This juice contained about 13 litres of normal juice (that is to say, the greater part of the residual juice contained in the double-crushed megass), and from 10 to 13 litres of added water. On mixing these 23 to 26 litres of juice (1·040 density) with the 66 litres of mill juice (1·067 density), there were obtained about 91 litres of juice at 1·060 density per 100 kilos of canes.

The direct diffusion of sliced cane, of the same saccharine richness, would yield about 105 litres of juice at 1·051 density per 100 kilos of canes.

The quantity of sugar lost per 100 kilos of canes may, therefore, be approximately stated as follows:—

2·25 kilos by	dry double-crushing.	
1·95	,,	double-crushing with maceration.
0·50	,,	dry double-crushing and diffusion of megass.
0·50	,,	direct diffusion of sliced cane.

These results were obtained in the diffusion of megass when the waste waters from the re-crushing mills was returned to the battery in such a manner that the small quantity of sugar they contained was not lost. Under these conditions, the only loss of sugar was that contained in the waste waters which the powerful re-crushing mills failed to extract from the exhausted megass. But this method of utilising the waste waters has been discontinued since it was found that they were liable to ferment; the battery was then supplied with fresh water, but this practice has been abandoned in favour of the former.

The working of the battery is simple, four battery hands being sufficient to conduct the diffusion when treating about 800 tons of canes per day. The only supervision necessary consists in seeing that the juice is brought to the proper temperature, that the extraction and the density of the diffusion juice are satisfactory, and that the alkalinity of the juice is sufficient.

The battery consists of 10 diffusers, whereas the direct diffusion of cane requires at least 16, and often 18, diffusers.

A usine adopting diffusion of megass therefore requires:—Two cane mills for dry double-crushing, or one crusher and a mill. Ten diffusers with carriers and elevators for handling the megass. Two re-crushing mills with carriers leading to the furnaces.

The latter mills may be smaller than the cane mills and require less power. Even a single mill might be employed, but the megass should be rendered as dry as possible if it is to be burned without preliminary drying in the sun.

Dry double-crushing generally furnishes sufficient fuel to meet the requirements of a usine because the mills extract a relatively small quantity of juice which is also of a high density. It should, however, be noted that such a usine utilises sugar as part of its fuel owing to the imperfect extraction of juice from the megass. It is quite evident that such working is neither rational nor economical.

On comparing the evaporation of 66 litres of juice at 1·067 density which give 17·7 litres of syrup at 1·25 density, with that of 91 litres of juice at 1·060 density which give 21·8 litres of syrup at 1·25 density, it is found that, in the case of megass diffusion, it is necessary to evaporate 21 litres more water per 100 kilos of cane than in the case of dry double-crushing; that is to say, 5 litres per body of a quadruple effect without re-heaters; but, on the other hand, recovering about four additional litres of syrup per 100 kilos of canes.

It is therefore easy to calculate the economy realised by the diffusion of megass, and this will be still more remunerative when the older usines are equipped with modern methods of re-heating the juice. The question of the total extraction of sugar from the cane is intimately connected with that of a well arranged evaporation plant. This problem of the total and economical extraction will only be

solved when, in every cane sugar factory, the multiple effet evaporator is regarded as a secondary boiler, intended to furnish the necessary heat to the various departments of the factory.—*Journal des Fabricants de Sucre.*

Editor's Note.—The process described in this article differs from the Hinton-Naudet Process in that the normal mill-juice does not enter the battery. Strictly speaking, the "diffusion" is a systematic maceration of the megass with water whereby a dilute juice is obtained which is finally mixed with the normal juice expressed by the cane-mill. This mixture is then clarified in the usual manner.

NEW ORDERS FOR SUGAR MACHINERY.

It is not without interest to learn what effect the abolition of bounties has had on the output of the sugar machinery manufacturers. The following report gives a typical instance of what one firm only have accomplished :—

"This year has been a most momentous one for those engaged in the manufacture of cane sugar machinery. The year opened with the placing of an order for a complete central sugar factory for Antigua with the Mirrlees Watson Company. A considerable portion of the capital was found by the British Government. The Mirrlees Watson Company designed and manufactured the machinery, selected the site, prepared the foundations, and erected the buildings, machinery, and all the equipment. The factory has just been completed, and run a satisfactory steam trial, ready for the opening of the campaign next year.

"In the early part of the year a number of orders were received from Cuba for heavy crushing and evaporating machinery; from New South Wales for the strengthening and reconstruction of existing machinery, and also from the Argentine Republic; for new crushing plants for Natal; and some very heavy double crushing and multiple effet evaporating machinery for Mexico. Later on in the year additional machinery was supplied for cane sugar manufacture in Spain, and in the middle of the year heavy crushing plant was supplied to our West Indian Colony of St. Lucia, and extra heavy evaporating, crushing, and macerating machinery for the Danish West Indian Colony of St. Croix. With the improvement in the price of sugar which was clearly indicated towards the latter part of the year has come a considerable influx of new business, and orders for vacuum pans have been received for the Argentine Republic, Mozambique, Natal, Demerara, and Berbice; as well as for the machinery for reorganising the evaporating plant of some of the large estates in the Argentine Republic, with further grinding plants for

the same country, and large installations for the handling of canes and the burning of green megass. There also has been a considerable number of replace portions supplied to Java, and new grinding plant for Brazil. The year closes with every prospect of considerable demand for new and improved machinery throughout the cane sugar world."

We also learn that the well-known firm of Harvey Engineering Company (late McOnie, Harvey & Co., Limited), Sugar Engineers, of Glasgow, have received the order for a Central Factory all complete for South Africa; this is similar to one supplied by them to Natal about three years ago, but *50%* larger. The contract includes iron buildings, workshops, and electric lighting throughout, the machinery to be of their newest design and with all their latest improvements to turn out the best sugar in the most economical manner, which from their long experience in this special line of engineering, they should have no difficulty in doing. This order proves that the cane sugar industry is extending all over the world, and no doubt further orders will follow.

THE PRESENT EXTENT OF OUR KNOWLEDGE OF DIFFUSION LOSSES.

Till a short while ago it seemed as if the question of the determined and undetermined losses in sugar manufacture had met with a generally recognised solution, in the sense that only unappreciable losses to the extent of 0·50 to 0·75 % arose, which were, moreover, clearly polarisation losses, *i.e.*, losses in dextro-rotary non-sugars, and not sugar losses, and that these losses did not occur in the diffusion battery, or else only to a trifling extent, but arose chiefly from the working up of the diffusion juices into intermediate and final products. Only in certain exceptional cases, such as in the working up of very dirty or decayed beets, was one inclined to admit, by way of exception, the occurrence of large losses in the diffusion battery as well, and only in isolated instances was the suspicion voiced that an appreciable destruction of sugar in the battery through the activity of micro-organisms was to be feared even in regular work, whereby the advocates of these views aimed more at theoretic conclusions and demonstrations than at practical elucidated losses; but they, too, estimated the loss occurring in the diffusion (which they, moreover, hoped to reduce considerably by employing antiseptic treatment) at approximately 0·50 % as a maximum. Here the matter rested till some two campaigns or so ago, when the Steffen process was put to practical tests in a factory, and soon one found that, with the same quantity of beets, a distinctly higher amount of sugar in all products had been gained, not excluding the usual losses, than was

the case with the diffusion processes, and even more than was present in the beets according to the analytical methods in vogue. These rumours were fully substantiated in the last campaign by the publication of the results at the Altfelde factory, according to which the yield in sugar by the Steffen process was in the mean 1·5 % in excess of that from the diffusion process, and 1·4 % more sugar was obtained in all products than could be obtained by alcoholic digestion of the worked up beets. In *other words, in the diffusion* process there had hitherto been an undertermined loss of 1½ % sugar which had escaped detection.

The question consequently arises: Is so high an undetermined loss a normal accompaniment of the diffusion process as carried on to-day, or is it not? I will endeavour in the following pages to answer this question so far as our present practical and theoretical knowledge will allow me; so that both the extent of these ascertained losses in practice may be established by unbiassed tests, and also that an attempt may be made to discover whether such losses are established from a purely scientific and theoretic standpoint.

Figurative examples of the extent of sugar losses are rare in literature, especially German literature, apart from official reports of sugar factories the examples from which are unfortunately far from trustworthy. Thus Lippman pointed out that in the reports of 16 factories 14 had a total loss of only 0·5 % or less, and some had even a gain in sugar; whereas, in normal practice, about 1 % loss must be reckoned. Such figures are evidently the results of defective control, such that the weight of beets is only estimated, or that the analysis of the beets and the intermediate and final products is accomplished by an inconclusive and defective method. For the last conjecture it may be said that the assertion made within the last few months, that the majority of such factories tested their beets after a method which discovered 1-1·5 % too little sugar, has passed uncontradicted through several debates. Working results which rest on such defective foundations can naturally not pass muster as standards for the real extent of the losses occurring, as can readily be perceived. Only such figures should be taken into consideration which are founded on standard methods of quantative estimation, sampling, and analysis of all the substances entering into the problem. As regards the estimation of sugar in beets, the best and most accurate method for a large factory is undoubtedly the hot water digestion. The still much recommended alcoholic digestion gives, it is true, accurate results, but only if undertaken with such scrupulous care as is almost impossible to expect in the factory laboratory with quantitative estimation; and if it is tried on insufficiently pulverised pulp, and for an insufficient period of time (20 minutes), it always yields too low a result. One cannot, therefore, place much value on figures of losses which rest on the

results of alcoholic digestion, and they are therefore left out of consideration in the following compilations.

Reliable figures of losses have, so far, been given only by von Claassen, in Germany. They show that the total losses amount to 1·20 to 1·50 %, and that of these 0·50 to 0·80 are undetermined. These latter losses resolve themselves into a very small amount of 0·10 to 0·20 during diffusion, while the balance of about 0·40 to 0·70 occurs in the subsequent treatment of the juice.

Thanks to Dr. von Claassen I am enabled to give the figures drawn from the results of the last three campaigns. They are as follows:—

	1901-2.	1902-3.	1903-4.
(*a*) Total losses	1·57	1·50	1·23
Of which determined	0·70	0·73	0·67
,, undetermined	0·87	0·77	0·55
(*b*) Loss during diffusion	0·64	0·70	0·63
Of which determined	0·52	0·53	0·53
,, undetermined	0·12	0·15	0·10
(*c*) Loss in working up juice	0·93	0·80	0·60
Of which determined	0·18	0·18	0·14
,, undetermined	0·75	0·62	0·46

According to this the total losses amounted to 1·23 to 1·57 %, the determined to 0·56 to 0·87 %, and of this only a very small proportion (which in general comes within the range of "errors in calculation") occurs as undetermined loss during diffusion, viz., 0·10 to 0·15 %.

A similar story is told by the figures of loss communicated lately by Dr. Mugge, which, however, failed to include information on the extent of undetermined losses in diffusion; according to them, a total loss of 1·20 % occurs, one-half determined, and the other undetermined.

A certain complement to this is given by the figures of loss arising in a number of Belgian factories under the simultaneous control of F. Sachs. They only give the losses arising during the working up of the juice, the losses being determined from the volume and composition of the diffusion juice. This basis assumes, under Belgian conditions, a very high accuracy, since the measuring of the juice and the taking of mean samples takes place under Revenue supervision. The collective losses arising here from the working up of the juice amounted, in the campaigns from 1892 to 1900, to 0·49—0·74 %, and of this 0·36—0·64 % was undetermined. These figures confirmed the hitherto doubtful supposition that a definite undetermined loss occurs after diffusion, almost exactly the amount arrived at in the experiments at Dormagen. If we compare the figures of the Belgian control with those of Dr. Mugge, we find in either case that during diffusion either none or very little undetermined loss occurs.

Finally, it may be recollected that Professor Herzfeld, when experimenting on a small scale, came to the same conclusion when he

worked with an experimental battery in exact imitation of current practice. He found undetermined losses of only 0·00 to 0·04 %, which increased when working abnormal roots to 0·17 and 0·32, an unavoidable yet small loss.

So much for figures of losses evolved in practice. I have confined myself in their choice to those examples which, either by description or else from personal knowledge, satisfied all the requirements of accurate analysis. They go to show that when the sugar content of the beets was determined by hot water digestion (which method gives the highest result), and with a control as accurate as possible, the undetermined losses in diffusion were very small, and only amounted to from 0·10 to 0·15 %.

We will now consider the different possible or conceivable sources of loss from a theoretic standpoint, and thus ascertain whether the results of practical experience are confirmed.

As is known, these undetermined losses are divided into apparent losses, polarisation losses, and sugar losses. Apparent losses arise from errors in weights or measurements, false sampling, and errors in analysis. Such losses occur, *e.g.*, when sampling fresh beet slices which are not protected from evaporation, or again, are taken only from the top of the heap where the longest slices and the ones richest in sugar are sure to be. Such an analysis results in too high a sugar content. As in the sampling, pulverising and weighing of the chips, an almost unavoidable loss through evaporation occurs, we have an explanation of a certain part of the undetermined losses of diffusion, 0·05 – 0·10 % to a greater degree of accuracy that many a so-called "apparent" loss.

Conversely, inaccuracy or lack of precautions in the methods of analysis, such as the alcoholic digestion, can show an apparent gain, *i.e.*, a reduction in the apparent loss, since the latter is concealed by an apparent excess of sugar. A phenomenon of this class is met with, at least in part, in those factories that find more sugar by the hot water digestion than the analysis of the introduced material allows for. According to my conviction, the sugar content of any given beets, tested in the average and accurately analysed by the hot water digestion (which digestion can also be done in a faulty manner), would be at least as high as the output of the hot process amounted to. As is well known the partisans of Steffen seek to prove (Steffen himself has seen fit to abandon this theory) that even the hot water digestion does not indicate the total amount of sugar which originally existed in the beets, because, as soon as the latter are sliced a considerable part of the sugar is decomposed by enzymes. But such a rapid decomposition is at variance with the character of the enzyme. At all events Pellet has practically proved the contrary of this assertion; he sliced

one-half of a beet, rasped the other half to a fine pulp, and exposed both to contact with the air. Subsequent analysis should have revealed in *the pulp* (which had the most intimate contact with the air), a more extensive decomposition with a corresponding decrease in polarization; but, as a matter of fact, the polarization of both was the same. According to Steffen, experiment proves the following that the hot water digestion does not give the total amount of sugar: a weighed amount of fresh slices is thrown immediately after slicing into boiling water, after the manner of the Steffen process, and stirred for a short ime; then lead acetate is added, the mixture weighed on cooling, and the liquid polarized. One should then obtain in this liquid a greater amount of sugar than is given by hot water digestion of the same chips.

But numerous experiments of this kind have been undertaken at Dormagen, and it was found that the yield in both cases was invariably identical within the limits of possible error. As an example the following tests may be quoted:—

(*a.*) Fresh slices, digested with hot water, mean of four tests = 15·63% sugar.

(*b.*) 500 grams of the same slices were placed in two litres of boiling water; after four minutes 100 c.cm. of lead acetate were added and the whole digested 45 minutes. Weight of the cooled mixture = 2552 grams, the filtrate confaining 3·11% sugar. Since 500 gr. of chips contain 25 gr. marc, the mixture contained (2552 — 25) 3·11 = 78·58 gr. sugar = 15·72 gr. sugar in the chips.

(*c.*) 500 grm. of the same chips were placed in two litres of cold water, heated for 15 minutes to 85°; 100 c.cm. of lead acetate were added, and the whole digested for 45 minutes. Weight of the mixture, 2108 gr.; filtrate 3·76% sugar; hence sugar in 500 gr. chips = (2108 — 25) 3·76 = 78·32 gr. = 15·66% sugar in the chips.

These examples show on the contrary that just as much sugar is obtained by the hot water digestion as by a process analogous to the Steffen one; and this has latterly been brought out strongly by Strohmer. The test under (c) also shows that no decomposition of sugar follows a long heating of the chips.

The other class of undetermined losses are those occurring in polarisation. The optical method of analysis of saccharine materials does not give, as is well known, any means of distinguishing the saccharose from the similar dextro-rotatory non-sugars; it is not established either how these latter comport themselves on the addition of lead acetate. The losses in degrees of polarisation may conceivably be losses of dextro-rotatory substances other than sucrose; but it is not probable that any noticeable polarisation losses occur in diffusion. The hot water digestion will extract from

the slices the dextro-rotatory non-sugars in the same measure as does the diffusion method. This can be well proved from experiments cited further on. Hot water digestion and diffusion are analogous processes, and it is not to be supposed that the dextro-rotatory sugar should here behave essentially otherwise. It is not, therefore, necessary to take account of the polarisation losses in diffusion till the contrary can be proved.

There only remains the chief question to be put: Are the conditions existing in the diffusion favourable for the actual decomposition of sucrose? To account for such a decomposition the following reasons can be given:—

(1.) Inversion of sugar in the presence of acids.

(2.) Destruction of sugar through the activity of micro-organisms.

(3.) Destruction of sugar by enzymes, whatever their *modus operandi*.

The destruction of sugar through inversion during the process of diffusion should become apparent by reason of the increased amount of invert sugar in the diffusion juice as compared with that in the beets used. But Classes has proved by repeated experiments extending over several years that the increase in the invert sugar is on the average only 0·1 %, corresponding to a maximum sugar loss of only 0·1 %. Jesser has come to the same conclusion. The objection raised, that the invert sugar continues to decompose, is but a feeble one, since so strong an increase in the amount of acids and lime salts, as would result from this kind of decomposition, is never observed. Now 0·1% of invert sugar combines with 0·023 parts of CaO to form 0·102 parts of lime salts, which are easily decomposed by alkalies, setting free a corresponding quantity of free alkali. Therefore, in a masse-cuite, representing 15% of the weight of roots, a reduction in alkalinity corresponding to 0·15 CaO and the formation of 0·68% of invert sugar might be looked for; but such inversion would be indicated by an excessive reduction in alkalinity and by a great increase of non-sugars in the masse-cuite, such as is only met with in exceptionally rare cases.

The destruction of the sugar might be attributed to the secret activity of micro-organisms. But here we plainly enter an obscure and unknown sphere. It is, in any case, certain that a large number of living organisms are introduced into the battery through the dirt or dirty water adhering to the beets, Schöne, and likewise Raschkowitz, counted up to 2,000,000 bacteria in 1 c.cm. of juice from a freshly filled diffuser.

Much less is known of the action of these bacteria, as amongst the numerous varieties existing only a very few have been accurately identified and their conditions of life investigated. Among those bacteria

which appear most frequently in the greatest nnmbers we have accurate knowledge of but two species: these are: the well-known *Leuconostoc mesenteroides*, and the *Clostridium gelatinosum*, which has been observed specially in the Bohemian factories, but, on the other hand, remarkable to relate, not at all in the German ones. The *Leuconostoc* attacks the sucrose after having first inverted it; it forms lactic acid, and but little gas, at the same time forms, at the expense of the sugar, enormous gelatinous masses of dextrine. According to Tieghem, 1 kg. of *Leuconostoc* requires about 600 gr. of sugar for its development. It cannot stand high temperatures, above 43° its activity is arrested, and at 83—86° it is destroyed in the presence of moisture. The *Clostridium* inverts and then destroys the saccharose by forming carbonic and lactic acids as the principal products of the combination; simultaneously it leads in a like manner to the formation of large gelatinous masses; it will stand a temperature of 90° for half an hour.

One may now desire to know how these and other micro-organisms comport themselves in the diffusion battery. During the "meichage" the larger part of the bacteria adhering to the surface of the chips are entrained and collect in the juice which is being drawn off; yet a certain amount remain behind in the chips. But the contents of the diffusers get heated more and more, and reach (in general work) a temperature of 50—60° in 5 or 10 minutes, and in 10—30 minutes one of 75—80° or more. Thus in a short time the vitality of the bacteria is already greatly weakened, and not much later they are completely annihilated (with a few possible exceptions). So matters rest till the penultimate and final vessels of the diffuser are reached, and favourable temperatures exist once more: but then the greater proportion of the microbes are killed, or at any rate much reduced in vitality, so that only those specimens entering in in the pressure water attain any activity. When spring water is used for the purpose their number is extremely small.

These theoretical conclusions on the behaviour of micro-organisms in the battery have, as is known, been lately established by Raschkowitz through direct experimentation; he found in a freshly filled diffuser at 30—40° nearly two million bacteria in 1 c.cm. of juice; but shortly afterwards, under the action of a temperature of 71°, the number was reduced to 2000, and towards the terminal cell of the battery even less were found.

(To be continued.)

Correspondence.

THE SUGAR CONVENTION IN RELATION TO SUGAR AND SUGAR MACHINERY.

To the Editor of "The International Sugar Journal."

Dear Sir,—As a sugar engineer, of some 30 years' experience, I should like to make a few remarks regarding the present discussion. Mr. Mathieson, in a letter recently published on the subject of the Sugar Bounty Convention, referred to the Blue Book of the West India Commission as his authority for the statement that cane sugar can be produced in Java at 6s. per cwt. The same Blue Book gives the cost of production of beet sugar on the continent at 9s. 6d. per cwt. I know both statements are correct, and, when the improvements are completed, which are now being inaugurated in the West Indies, with capital now being invested owing to the security guaranteed by the abolition of bounties, I have every reason to believe that sugar will be produced as cheaply there as in Java. That being so, the effect of the Convention will, eventually, be to secure, for British consumers, a supply of sugar at a price based on the cost of production of 6s. instead of 9s. 6d. per cwt. This will mean a large future extension and improved development in all those countries where the sugar cane can be cultivated, and, as British made sugar machinery has a good name wherever cane sugar is made, and competes successfully with American machinery in Cuba and Central America, this means a greatly increased demand for sugar machinery in this country, and, therefore, a large increase in the number of men required to manufacture the same. I may state, from my business connection, as a sugar engineer in Glasgow and London, that the good effect of the abolition of sugar bounties has resulted in considerable orders already being placed in this country for most of the cane-growing countries all over the world, which means increased employment for the working man here.

Beet sugar, on the contrary, is all manufactured by machinery made on the Continent, where tariffs are against the importation of sugar machinery made in this country; there is, therefore, no British labour employed in the production of this sugar.

Would Mr. Mathieson be satisfied with cheaper sugar? I fear not. What would it profit him if he bought his sugar at 5s. per cwt., if his French and German competitors could get it at the same price? What he wants is protection; what the West Indian planter wants is a fair field and no favour; and the planter is as much a British subject as Mr. Mathieson.

If confectioners and jam makers cannot compete against the foreigner, when both pay the same price for sugar, then their business must be, as they say, in a very bad way. This shows the danger of building up a business on a false foundation, which, in their case, was buying sugar at an unnatural price, caused by the Continental Bounties on sugar, which allowed these countries to sell their sugar over here £2 per ton below the cost of production, and by the high duty on the importation of sugar into those countries, the loss was more than made up from the very high price they charged their own people; this could not go on for ever, but it gave the confectioners and jam makers in this country an unnatural advantage over all other countries, and so their business extended, and immense profits were made, but now they must submit to fair competition and reduced profits. They were at the mercy of the Continental Governments for their cheap sugar; our Government could not insist upon these bounties being continued; and when the principal—in fact *all* the beet producing countries called a meeting to consider how to end this heavy drain on their treasuries, England, to be fair to her West Indian Colonies, agreed (on being requested by these countries) to join the Brussels Convention; and thus an agreement was come to whereby we now have free and fair trade in sugar.

As a proof that the present price is merely temporary, sugar can to-day be bought forward for next year's delivery at about £3 below the present price. At the present moment British Confectioners are buying their sugar cheaper than their Continental competitors, and yet they say they cannot compete. They must therefore take the advice so freely tendered to the West Indian Planters in their extremity,—to try something else, or to improve their methods of manufacture! It is strange that we do not hear any complaints from the jam manufactures regarding the fluctuation in the price of the fruits they use, and which varies, at times, from 200% and upwards. This is a greater fluctuation than in the case of sugar, and fruit forms a large proportion of their raw material.

It is a great mistake to turn this Sugar Question into a political one, because it is useless for the following reason: Suppose, when the present term of the Brussels Convention is expired and the Opposition are in office, and they repudiate or do not again become signatories to the renewed Convention, or even suppose there should be no further Convention, would any sane person believe that any of the Continental Governments who are at present in the Convention would return to the old state of things and pay bounties on sugar exported to England—which would necessitate the old surtax on sugar and which means an increase in the price of sugar to the whole of their people—for the benefit of the Confectioners, Jam Makers, and Soda Water Manufacturers in this country?

The Governments of France and Germany have both been harassed for a number of years before the Brussels Convention as to how they could rid themselves of the increasing heavy drain on their Treasuries by paying these bounties, and now they have got rid of this Old Man of the Sea they will not take him on again. The working classes on the Continent who have now got the benefit, and feel the advantages in many ways, of sugar at a moderate price, will not submit again to the old state of things. I know that these are the facts of the case from my personal experience and the remarks I have heard regarding the same on the Continent. It is well known in the sugar world that, as the production of beet is at present much in excess of cane, the beet naturally gives the basis price of sugar all the world over, but I have no doubt that a few years hence the production of cane will exceed the production of beet, which it did before bounties were given; therefore the price of cane sugar will then rule the market, and as this, as I have stated, is about £3 per ton lower than that of beet sugar, the whole world all over will benefit thereby. There will also be a greater security for a more steady supply, having the two sources to draw upon, which would lessen the chances of fluctuation that might be caused by a short crop of beet owing to the weather, as we have seen this year.

It is true that the increased price of sugar has arisen partly from the increased consumption on the Continent, owing to the reduction in price there. This was but natural, and to be expected, but no one could foretell to what extent, and it seems to have been underestimated; but no doubt this will be remedied in the future, when such increased consumption may be estimated more correctly.

The abolition of Continental bounties on sugar will put the West Indian Colonies on a sound basis for the investment of capital, and the extension of the Sugar Industry there means much to this country in the way of machinery and supplying stores of all kinds to the sugar estates, with more ships to carry these goods and increased passengers, all this meaning employment for the workshops in this country, the evidence of which is to be seen in the beautiful and fast steamships now being built by Sir Alfred Jones for direct service to the West Indies; also the Royal Mail and other steamers sailing from this country, will greatly benefit by this Convention.

ROBERT HARVEY, M.I.M.E.

MONTHLY LIST OF PATENTS.

Communicated by Mr. W. P. THOMPSON, C.E., F.C.S., M.I.M.E., Chartered Patent Agent, 6, Lord Street, Liverpool ; and 322, High Holborn, London.

ENGLISH.—APPLICATION.

26713. O. OBERLANDER and THE ALLIANCE CHEMICAL COMPANY, LTD., Bury. *Improvements in the manufacture of saccharine.* 8th December, 1904.

ABRIDGMENTS.

11854. W. KATHOL, of Vailsburg, County of Essex, State of New Jersey, United States of America. *Improvements in filters.* 24th May, 1904. This invention relates to a filter comprising a tank having an inlet and an outlet, a filter bag within said tank, said bag having a lateral sleeve at the top, and a discharge pipe connected with said outlet and extending within the bag along the top thereof and through the said sleeve.

20857. J. KOSTALEK, Prague, Austria. *Improvements in and relating to filters.* 28th September, 1904. This invention has for its object to provide a filter wherein (1) during the filtering operation pure filtrate is delivered in large quantities for industrial purposes, as in the manufacture of sugar, and (2) after the filtration is completed the washing of the filtering medium takes place rapidly and automatically within the filter vessel.

25097. J. W. MACFARLANE, Kingston, Glasgow, N.B. *Improvements in and connected with spindles for centrifugal machines.* 18th November, 1904. This invention relates to a spindle for a centrifugal machine comprising inner and outer revolving spindles and a stationary sleeve between the spindles : the inner spindle being of like diameter throughout or of least diameter below the stationary sleeve and being so secured to the outer revolving spindle that it may be withdrawn therefrom upon the removal of a taper pin or other fixing device.

GERMAN.—ABRIDGMENTS.

15392. ANTON WAGNER, of Sehnde, near Hanover. *An evaporating and boiling down apparatus having two or more superimposed heaters and baffle plates for regulating the circulation of the juice and the masse-cuite.*

April 22nd, 1903. In this evaporating and boiling down apparatus having two or more superimposed heaters and baffle plates for regulating the circulation of the juice and the masse-cuite, a distributing plate is arranged between each two heaters, only the upper one of which has the usual central circulation aperture, said distributing plate keeping the circulation aperture free for the descending masse-cuite, and distributing over the heating pipes of the two heaters both the rising masse and also that which is descending through the circulation aperture.

153284. CAMILLE POIGNON, of Nantes. *A sugar pressing machine.* 9th May, 1903. The sugar pressing machine is characterised by vertical and horizontal partitions being arranged in the recesses between the pressing stamps, by means of which partitions the pressing stamps in their return are cleaned. The vertical partitions extend preferably close up to the mould in order that the masse may be divided into slabs even before the pressing. The pressing and pushing apparatus is provided at its rear part with vertically and horizontally arranged recesses in order to create an outlet for the masse which has penetrated into the interstices between the stamps.

154987. ALFONS LEWENBERG, of Warsaw. *A method of making saleable lump sugar from air dried crystal sugar by treatment with steam.* 18th March, 1902. In the manufacture of saleable lump sugar from white air dried crystal sugar by treating it with steam, the crystal sugar being converted by the condensing steam into a sugar solution and this then again allowed to harden, the crystal sugar is preferably heated previously by means of hot air in order to prevent too free a formation of condensed water.

155224. HEINICH KOŘAN, of Meziric, Bohemia. *Method of and apparatus for separating beetroots and their radicles from foreign substances.* February 27th, 1904. This invention has for its object to free beetroots and their radicles from foreign substances and more particularly to allow of the radicles being retained and utilized. The method consists in separating the beetroots and their radicles both from the heavier as well as the lighter foreign substances by means of two liquids one of greater and the other of smaller specific gravity than the beets. The apparatus for carrying out the operation consists

of a vessel divided into two compartments by means of a vertical partition and provided with a roof-shaped bottom. The left hand compartment is filled with a liquid of greater specific gravity than beetroot, and the right hand compartment with a liquid of less specific gravity than beetroot, so that in the left hand compartment the beetroots and radicles are freed from the heavier impurities falling against the bottom, whilst after the floating beetroots and radicles and also the other lighter impurities have been thrown over into the other compartment by means of a scoop or shovel pivoting on pins, the beetroots and radicles fall against the bottom and are freed from the lighter impurities, and conveyed to an apparatus for further treatment.

Copies of all published specifications with their drawings in these lists can be obtained from W. P. Thompson & Co., 6, Lord Street, Liverpool, at One Shilling a copy for English or American Patents, and Two Shillings for German. In ordering please give number and date.

Patentees of Inventions connected with the production, manufacture, and refining of sugar will find *The International Sugar Journal* the best medium for their advertisements.

The International Sugar Journal has a wide circulation among planters and manufacturers in all sugar-producing countries, as well as among refiners, merchants, commission agents, and brokers, interested in the trade, at home and abroad.

The latest advices are that the next Cuban crop will not exceed 1,250,000 to 1,300,000 tons.

According to the *Financial Times*, an important French engineering firm intends to erect an extensive plant in Canada for the manufacture of various classes of railway supplies and machinery connected with the beet sugar industry. The outlay will probably be in the neighbourhood of £70,000.

IMPORTS AND EXPORTS OF SUGAR (UNITED KINGDOM)

To end of November, 1903 and 1904.

IMPORTS.

Raw Sugars.	Quantities.		Values.	
	1903. Cwts.	1904. Cwts.	1903. £	1904. £
Germany	5,009,176	5,863,562	2,114,343	2,815,034
Holland	187,450	699,148	72,541	381,719
Belgium	674,363	848,773	279,143	453,303
France	527,521	496,137	230,794	262,241
Austria-Hungary	1,588,984	699,203	666,813	317,940
Java	449,261	1,869,074	218,536	911,112
Philippine Islands	70,646	87,025	25,285	31,165
Cuba	445,184	....	215,443	....
Peru	333,824	922,845	137,290	440,775
Brazil	69,148	84,257	27,074	32,295
Argentine Republic	418,386	....	184,711	....
Mauritius	305,164	524,999	109,396	198,838
British East Indies	273,598	201,859	101,153	82,188
Br. W. Indies, Guiana, &c.	597,333	913,331	359,425	602,922
Other Countries	477,710	489,717	210,450	241,791
Total Raw Sugars	11,427,748	13,699,930	4,942,397	6,771,323
Refined Sugars.				
Germany	13,302,649	9,643,909	6,983,814	5,640,381
Holland	2,029,954	2,956,474	1,193,378	1,835,318
Belgium	125,507	504,801	73,642	304,068
France	816,245	2,572,513	463,038	1,507,312
Other Countries	870,048	180,400	431,162	95,785
Total Refined Sugars	17,144,403	15,858,097	9,145,034	9,382,864
Molasses	1,510,036	1,700,682	275,954	313,280
Total Imports	30,082,187	31,258,709	21,363,385	16,467,467

EXPORTS.

British Refined Sugars.	Cwts.	Cwts.	£	£
Sweden and Norway	31,879	32,066	16,076	17,815
Denmark	92,699	98,826	50,520	51,289
Holland	62,990	62,939	33,762	35,688
Belgium	10,727	10,157	5,470	5,605
Portugal, Azores, &c.	9,693	17,353	5,529	9,662
Italy	8,132	4,258	3,780	2,145
Other Countries	767,893	323,746	472,759	214,507
	984,013	549,345	587,896	336,711
Foreign & Colonial Sugars.				
Refined and Candy	40,412	22,761	25,225	16,020
Unrefined	56,038	96,965	29,706	54,422
Molasses	1,889	2,319	905	1,219
Total Exports	1,082,352	671,390	643,732	408,372

UNITED STATES.

(Willett & Gray, &c.)

(Tons of 2,240 lbs.)	1904. Tons.		1903. Tons.
Total Receipts, Jan. 1st to Dec. 22nd ..	1,894,535	..	1,609,127
Receipts of Refined ,, ,, ,, ..	569	..	1,364
Deliveries ,, ,, ,, ..	1,906,696	..	1,596,423
Consumption (4 Ports, Exports deducted) since 1st January	1,854,107	..	1,656,526
Importers' Stocks (4 Ports) Dec. 21st ..	....	..	16,089
Total Stocks, Dec. 28th.	87,000	..	63,835
Stocks in Cuba, Dec. ,, ...	22,000	..	105,787
	1903.		1902.
Total Consumption for twelve months ..	2,549,643	..	2,566,108

CUBA.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1903 AND 1904.

(Tons of 2,240lbs.)	1903. Tons.		1904. Tons.
Exports	879,200	..	1,090,061
Stocks	122,638	..	682
	1,001,838	..	1,090,743
Local Consumption (twelve months)	39,570	..	44,320
	1,041,408	..	1,135,063
Stock on 1st January (old crop)	42,530	..	94,835
Receipts at Ports up to November 30th ..	998,878	..	1,040,228

Havana, 30th November, 1904. J. GUMA.—F. MEJER.

UNITED KINGDOM.

STATEMENT OF IMPORTS, EXPORTS, AND CONSUMPTION FOR ELEVEN MONTHS ENDING NOVEMBER 30TH.

SUGAR.	Imports. 1902. Tons.	1903. Tons.	1904. Tons.	Exports (Foreign). 1902. Tons.	1903. Tons.	1904. Tons.
Refined	849,000	.. 857,220	.. 792,905	2,129	.. 2,021	.. 1,138
Raw	596,571	.. 571,387	.. 684,996	4,241	.. 2,802	.. 4,848
Molasses	62,641	.. 75,502	.. 85,034	126	.. 94	.. 116
Total	1,508,212	..1,504,109	..1,562,935	6,496	.. 4,917	.. 6,102

	Home Consumption. 1902. Tons.	1903. Tons.	1904. Tons.
Refined	845,675	.. 807,975	.. 800,643
Refined (in Bond) in the United Kingdom	—	.. 48,309	.. 490,854
Raw	573,449	.. 411,900	. 114,596
Molasses	60,336	.. 72,384	.. 78,491
Molasses, manufactured (in Bond) in U.K.	—	.. 8,161	.. 55,943
Total	1,479,460	.. 1,348,729	.. 1,540,527
Less Exports of British Refined	33,149	.. 49,201	.. 27,467
Total Home Consumption of Sugar	1,446,311	.. 1,299,528	.. 1,513,060

Stocks of Sugar in Europe at uneven dates, Dec. 1st to 28th, compared with previous Years.

In thousands of tons, to the nearest thousand.

Great Britain.	Germany including Hamburg.	France.	Austria.	Holland and Belgium.	Total 1904.
106	1107	684	542	185	2625

	1903.		1902.		1901.		1900.
Totals	3256	..	3022	..	2862	..	2417

Twelve Months' Consumption of Sugar in Europe for Three Years, ending November 30th, in thousands of tons.

(Licht's Circular.)

Great Britain.	Germany	France.	Austria.	Holland, Belgium, &c.	Total 1903-4.	Total 1902-3.	Total. 1901-2.
1777	1085	681	477	191	4210	3723	3655

Estimated Crop of Beetroot Sugar on the Continent of Europe for the current Campaign, compared with the actual crop of the three previous Campaigns.

(From Licht's Monthly Circular.)

	1904-1905. Tons.	1903-1904. Tons.	1902-1903. Tons.	1901-1902. Tons.
Germany	1,590,000	1,927,681	1,762,461	2,304,923
Austria	905,000	1,167,959	1,057,692	1,301,549
France	620,000	804,308	833,210	1,123,533
Russia	940,000	940,000	1,256,311	1,098,983
Belgium	170,000	203,446	224,090	334,960
Holland	135,000	123,551	102,411	203,172
Other Countries.	335,000	431,116	325,082	393,236
	4,685,000	5,864,938	5,561,257	6,760,356

THE

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All Advertisements to be sent *direct*.

Cheques and Postal Orders to be made payable to Norman Rodger, Altrincham.

☞ The Editor is not responsible for statements or opinions contained in articles which are signed, or the source of which is named.

NOTES AND COMMENTS.

Affairs in Demerara.

The exports of sugar from Demerara for the past year have amounted to 107,436 tons, as compared with 132,916 tons in 1903. The decrease is accounted for by adverse weather conditions. Heavy weather in the early part of the year was followed by a prolonged drought. Molascuit was exported to the extent of 7,615 tons; this product is now established commercially, and will prove a valuable addition to the income of the manufacturers. Local prices, which were as low as $1·82 per 100 lbs. for 96° crystals in January, had risen to $3·10 in December.

Experiments with seedling canes have continued; D 625 is now considered the most promising variety, and its cultivation is being pushed forward. D 109, D 145, B 147, and B 208 are being given a further and more extensive trial; but D 74, D 95, and D 78 have fallen into disfavour. The acreage under seedling cane cultivation amounts in all to 15,000 acres; but opinions are expressed that no seedling yet combines the all-round properties of the *Bourbon*.

The number of factories at work is now 45; and the average output per factory may be estimated at 2,500 tons. Two estates have gone out of cultivation during the past year. Better prices have resulted in much new machinery being erected, and on the whole factories are now well equipped. The improvements have been largely in connection

with water-tube boilers, and the manufacturing department as distinct from the milling department.

Stocks of Sugar on September 1st, 1905.

M. F. Sachs in the current number of the *Sucrerie Belge* gives his annual statistics on the stocks of sugar existing on the first of September. He commences by referring to the extraordinary agitation existing in the sugar industry, in consequence of the bad harvest and the increase in European consumption surpassing all expectations. As a consequence—stocks have been depleted rapidly and more than half a million tons less sugar was in hand last September than twelve months previously.

The cane crop to be reaped between now and next September is the most important factor to be considered, The total figure of the crop for this season is variously estimated, but the mean of the three best experts is 4,714,333 tons. Of this, 456,611 tons have already been disposed of, so during the next seven months 4,257,722 tons will be available for the market.

The total amount of sugar in hand next September as compared with previous seasons is given by Sachs as follows:—

	1904-05.	1903-04.	1902-03.
Remaining production (five countries)	541,497	1,086,313	1,011,967
World's Stocks on December 1st	2,823,568	3,594,640	3,496,440
Remaining Cane Production	4,257,722	3,802,113	3,697,249
Surplus of Russian Export	100,000	—	—
	7,722,787	8,483,066	8,205,656

Supposing the consumption of sugar in Europe from December 1st to August 31st is the same as during the same period of 1903-04, the probable stocks available on 1st September, 1905, will be 723,602 tons expressed in raw sugar.

This amount will be at the most sufficient for September's consumption. But Sachs expresses the view that the figures of consumption may prove excessive; the high price of sugar will have an unfavourable influence on consumption for the next few months, so that the visible stocks may be somewhat larger than are given above. Finally, an almost certain increase in the sowings will, in the event of fine weather, have its influence on the next sugar campaign. M. Sachs' final counsel is to the effect that prudence and an absence of exaggerated optimism will prove the wisest course.

The New Central Factory at Antigua.

On December 19th a pleasing ceremony took place in Antigua; it was the day of the official opening of the New Centrale, known locally as Gunthorpe's Factory. The proceedings began with a

religious ceremony. Lady Knollys, the Governor's wife, then broke a bottle of wine over the flywheel of the mill engine, and Mrs. Watts proceeded to feed the mill with the first cane. The inevitable banquet followed, at which several interesting speeches were made. Sir Courtnay Knollys referred to the fact that as far back as 1872 Sir Benjamin Pine appointed a Commission to report on the Usines in Martinique and Guadeloupe. Since then spasmodic efforts have been made from time to time, but without tangible result till just now, when they stood there to crown the efforts of 34 years. He paid a tribute to the energy and persistence of Sir Gerald Strickland and Dr. Watts, in Antigua, and Mr. du Boisson and Mr. Robert Bromley, in England, in bringing about success. The mill was designed to produce 30 tons of 96° grey crystals per day, and to take 4,500 tons of farmers' cane per annum, for which payment, though on a sliding scale, was not to exceed 7s. 6d. per ton delivered on the factory railway. Dr. Watts touched on his long labours in the island, and his endeavours to have an up-to-date factory in existence. He expressed the hope that both men and machinery would work together smoothly, and thereby assure a successful start. He emphasized the importance of such success, because the other West Indian islands were waiting to see the results of this scheme before embarking on their own account on similar lines, and if failure was recorded, it would put an end to all such efforts for years to come. In conclusion, Dr. Watts referred to the immense aid the scheme had received at the hands of Mr. Chamberlain and the other authorities at the Colonial Office.

It may be added that the real commencement of operations will be during this month when the grinding starts. We learn that the factory authorities will have the experienced aid of Mr. H. Scott Heriot, of the firm of Mirrlees Watson Co., Glasgow, the makers of the machinery, to get things going smoothly.

We learn that Messrs. Geo. Fletcher & Co., Derby, have been appointed sole makers in this country of Messrs. Beyer & Arbuckle's patent Film Evaporating Apparatus, and at the present time have two sets on order. This same firm are busy on new contracts for sugar machinery, which include a complete installation for Brazil, milling plants for the Leeward Islands and St. Croix, crystallisers, evaporators, vacuum pans, and centrifugal plant for South America. We are glad to know that British sugar machinery manufacturers are so well employed.

In Demerara, 20,000 acres are under rice cultivation.

MODERN SUGAR MACHINERY.

While, for the last decade, the beet sugar industry has been kept as nearly perfect in its equipment as science and skill could allow, the cane sugar industry, especially in those countries which, being unaided by State subsidies, the full force of the bounty system was most felt, matters had been allowed to assume a *laisser faire* condition; no new plants were ordered, there being no money forthcoming to purchase them with. Hence antiquated and obsolete designs and systems were in far too many cases allowed to exist at work much beyond their "alloted span."

Now with the abolition of bounties and a return to the policy of a "fair field and no favour," a general overhaul of such obsolete stock is everywhere taking place. New mills are being ordered, plans for erecting central factories are being reformulated with a better chance of success, and, in short, everywhere there is a desire expressed to get into as up-to-date a condition as funds will allow.

We therefore think it is not an inopportune time to place before our readers some details of the latest designs of sugar machinery as manufactured by the leading firms; they will thereby be enabled to perceive the salient features of such machinery and gain an accurate idea of what the "best" and "the most up-to-date" partakes of. We must point out, however, that we obviously cannot include all makes and designs in our summary, and what is not mentioned is not necessarily inferior in any way.

For convenience' sake, we propose dealing first with "Centrifugals." Here, it must be admitted, the makers have always kept abreast of the times, and the factories have not got so far behind as in some of their other departments; yet the newest patterns are worthy of a careful study.

I.

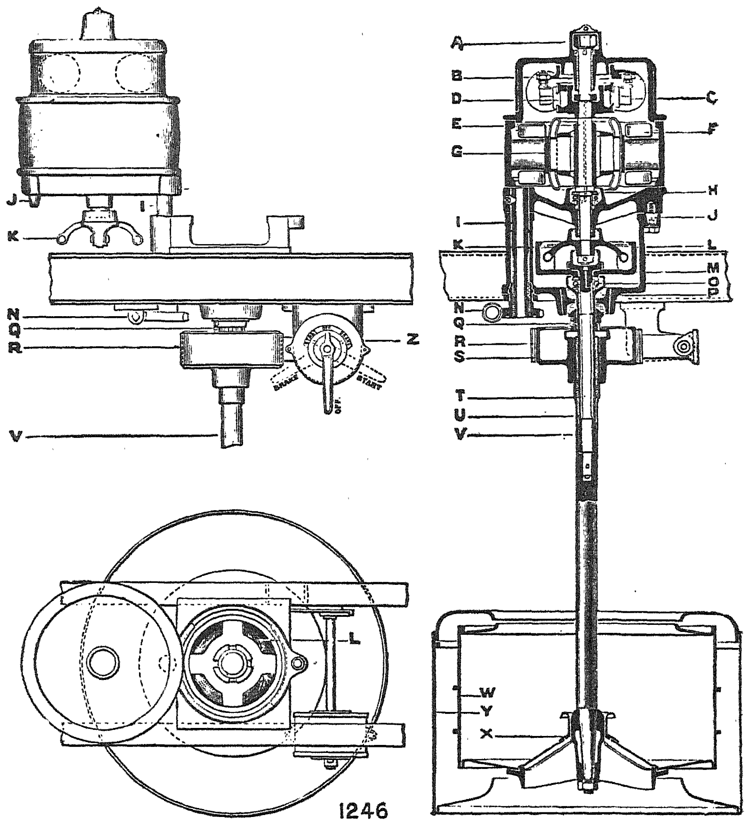
CENTRIFUGALS.

Although the accomplishment of successful electric driving of centrifugal machines is regarded as a comparatively recent achievement, it is over twenty years since attention was first given to driving centrifugal machines by this power, and such a machine was made and set to work in a refinery as far back as 1883-4.

Since that period electrical science has made considerable progress, and we now give our readers some particulars of the developments attained in this line of work.

The particular method adopted by Messrs. Watson, Laidlaw & Co., enables the motor to be carried upon the framework of the machine, and it does not require the latter to be of special construction; the centrifugal, therefore, is very much on the same basis as ordinary

machinery which may be driven by an electro motor through a coupling. This coupling is simply a friction pulley of smaller size than usual which provides for the modified oscillation at that point. The motor itself does not oscillate but is fixed rigidly to the framework; it is, however, made to hinge to one side to allow the centrifugal spindle to be withdrawn or for the examination of the upper end parts of the centrifugal generally. In this way the motor is designed, as such, in the most efficient manner, since no provision has to be made in its design to fit any special conditions.



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The use of a frictional pulley as a coupling between the motor and the centrifugal allows the motor to attain its speed rapidly, the centrifugal following until the motor and centrifugal are running at

the same speed, the action being exactly the same as the standard "Weston" centrifugal belt friction pulley drive, and the presence of rheostats in the electrical circuit when starting the motor is considered unnecessary.

The method of connecting the motor to the centrifugal is clearly shown in the illustration and is very simple. A friction pulley M rigidly attached to the centrifugal spindle has within its rim a number of friction blocks L which are preferably of wood. On the motor spindle is keyed the driver K, the horns of which enter between the blocks L and drive them when the machine is at work, but which are not in any way attached to the blocks L.

When the motor is started by the operation of the switch Z it immediately rises to a high rate of speed and the centrifugal force of the blocks L causes them to exert a drag on the pulley M which quickly brings the centrifugal basket up to speed. If now any oscillation takes place the only effect is to cause a slight rubbing of the horns K over the ends of the blocks L and no appreciable side pressure is brought to bear on the motor spindle or bearings.

Since the centrifugal force of the blocks L depends on their weight as well as on their speed it follows that the drag on the pulley M, and therefore the rate of acceleration of the centrifugal, can be altered by changing the blocks L for blocks which are heavier or lighter, the change being accomplished in a few minutes. This is obviously a great advantage when sugars of different classes have to be treated in the same machine.

The motor is fixed to a hollow post I, through which the wires are taken from the switch to the motor. This post can be raised by means of the worm and worm wheel N so as to allow the horns of the driver K to clear the friction pulley M. The motor can then be swung round out of the way and any repair carried out on the centrifugal spindle or the whole centrifugal can be removed without further disturbing the motor. The wires passing up through the hollow post are not disconnected when the motor is swung round, so that no electrical connections need be disturbed when merely an adjustment or repair of the centrifugal or its spindle is contemplated.

This is a great advantage when it is considered that the men about a sugar factory are seldom electrical experts, and where electrical faults due to improper connections might cause serious inconvenience.

The complete operation of removing pin J raising and swinging the motor, replacing motor and pin J ready for work again, does not require more than a few minutes. The motor illustrated has a ball thrust bearing H, to support the weight of the armature and the journal bearings are plain oiled bushes. In order to ensure that these vertical bearings are properly and regularly oiled, the top end of the motor is provided with a special oil cup A, which is so arranged

that it delivers only a small measured quantity of oil every time the motor is started. The capacity of the cup is such that it will hold about a week's supply and the machine will therefore run that length of time without requiring further attention.

The oil, after lubricating the motor top bearing, passes down a hole in the spindle to the bottom bearing of the motor and from thence it passes into the centrifugal spindle and after lubricating the bearings there it finally collects inside the brake pulley S from which it is drawn off about once a month.

Both motor and centrifugal may be fitted entirely with ball bearings and in such case oil is not required. The bearings are simply filled with grease and will work for months without attention.

Z represents the starting switch usually fitted to this type of electrically-driven machine. For continuous current motors it is usually of a simple, strongly-built, two-pole, rapid break type, and for three-phase motors a similar switch but with three poles instead of two. This switch, by a special arrangement, is interconnected with the brake so that it is impossible for the brake and current to be on at one time, thus avoiding risk of overload on the motor. It has, in fact, three positions :—

1st. Current on, brake off, machine running.

2nd. Brake on, current off, stopping the machine.

3rd. Current off, brake off, machine free to turn by hand for discharging the dried sugar.

This arrangement possesses an advantage over the other systems in which two handles have to be operated, one for the switch and one to apply or remove the brake.

The motor illustrated is a continuous current machine, but polyphase motors are applied in exactly similar fashion where such are required to suit the available current supply. The polyphase motor can also be connected up to the centrifugal directly through the medium of flexible coupling (which allows for oscillation) instead of by means of the friction blocks L in which case the motor rises to speed along with the centrifugal instead of running up to a fairly high speed at once, as is the case when the friction pulley is used. When spring links are used the excess of power at start is dissipated in a suitable resistance instead of being lost in the friction pulley as in the other arrangement.

We are informed by the makers that there are machines at work which are capable of taking forty to seventy horse-power at the moment of starting and these motors are switched directly on the mains and pick up their loads quite quietly and without shock.

The principal features of this type of electrically-driven centrifugal machines may be briefly summarised as follows :—

The motor is separate from the centrifugal proper.

The design and construction are simple.

The motor, being above the centrifugal, is out of the way of the attendant and not easily splashed by sugar or washing liquid.

All working parts are readily and rapidly accessible.

Ample bearings for heaviest loads.

A combination of electro-motor and centrifugal on well-established mechanical principles.

The system is equally suitable for direct or alternating current, since the centrifugal parts remain the same whatever type of motor may be used.

This same firm's water-driven centrifugals are so well known that they require no more than bare mention ; from all accounts they appear to meet with invariable satisfaction wherever they have been erected. It is largely a matter of local conditions of supply as to whether electric or water driven are the most economical and convenient.

(To be continued.)

THE PRICE OF SUGAR.

Among all the literature that has lately flooded the papers on this subject, we fancy the following simple figures have an eloquence of their own.

The monthly average price of beetroot sugar during the first year of the Convention, September 1st, 1903—August 31st, 1904, and of the four following months during which the disastrous crop was being reaped, was :—

	Month		Per cwt. f.o.b. Hamburg. s.	d.	
First year of the Convention. Average price, 8s. 9¼d.	September,	1903	8	5	
	October,	,,	8	8½	
	November,	,,	8	6	
	December,	,,	8	4½	
	January,	1904	8	0¾	
	February,	,,	7	10¼	
	March,	,,	8	3¾	
	April,	,,	8	7	growing season.
	May,	,,	9	2½	
	June,	,,	9	2¾	
	July,	,,	9	7½	
	August,	,,	10	4½	
	September,	,,	10	9¾	crop period.
	October,	,,	11	0½	
	November,	,,	13	5½	
	December,	,,	14	2¼	

A few quotations from a trade circular* will show that even in absolutely neutral and essentially dry, hard, commercial quarters, the idea of the Convention having had anything to do with the price of sugar, except by increasing consumption, was never even dreamed.

"When the year opened first products Beet were quoted at 8s. 4½d. f.o.b., but the burden of supply was then too great to admit of even this moderate price being maintained."

"Many Java cargoes, intended for the American markets and then on passage to Barbados for orders, were thrown on the British markets, and were disposed of at prices 3d. to 6d. under the current value of beetroot."

In March, "It became manifest that the rapid increase of consumption on the Continent in consequence of reduced duties there would soon bring supply and demand into nearer adjustment, and as there were indications of a slight decrease of sowings for the next beetroot crop, confidence began slowly to revive, and by the end of March first products beet had recovered to 8s. 6d. f.o.b."

In May, "there was the promise of superabundant fruit crops both in Europe and America, and the increase in Continental consumption showed no signs of diminution." . . . . "It was manifest that consumption would be still further increased by the abundant fruit crops, and that, even with a beetroot crop in prospect as large as its predecessor and cane crops somewhat increased, there would be a material reduction in stocks for months to come."

"The Cuban crop had given promise of exceeding 1,200,000 tons, but the early setting-in of the rainy season in May disappointed this expectation, and brought the estimate down to a maximum of 1,000,000 tons." Therefore:

"As anticipated, America made purchases of beetroot in the last days of June and during July of about 60,000 tons, and under these operations values improved 3d. to 6d. per cwt., the quotations of first products beet on 1st August being 9/9 to 10/- f.o.b."

"If no unseen circumstances had arisen to upset previous calculations, this might have proved the highest point of the year,—it was a price more than remunerative to the grower, and one which would encourage an extension of the area of cultivation for the following season. It was, therefore, felt that a point of danger had been reached and many operators thought it prudent then to realise their holdings."

"It was at this period, however, that a new element came into prominent consideration,—an element destined to alter the whole course of the market. It was well known that the weather in Europe had been intensely hot and dry during June and July, so much so that the Elbe and other rivers had been rendered unnavigable. But

* William Connal & Co., Brokers, Glasgow.

the idea of injury to the beetroot crops had so far been dismissed as improbable—all former experience had shown that the apparent damage of months could be repaired by a few weeks of soaking rains. When, however, these rains did not come in August, and only partially in September, grave fears began to be entertained for the safety of the crops, and the market became extremely sensitive, while the quotation for first products beet gradually crept up to 11s. 3d. f.o.b. by the end of September. Confirmation of those fears was expressed in the buying back of their forward contracts on the part of Continental fabricants and refiners, especially by those of Austria, where the drought was being most severely felt."

Then follow the various estimates of the crops, beginning early in October with—

	Tons.		Tons.
Giesecker	5,545,000	F. O. Licht ..	5,120,000
Otto Licht	5,130,000	Centralblatt	5,425,000

"This was followed, on the 31st, by the publication of the Factory estimates, giving 4,630,000 tons as their valuation of the crop, while Mr. Otto Licht, at the same time, reduced his figures from 5,130,000 to 4,950,000 tons."

"This confirmation of the crop being far inferior to previous expectations, gave an immediate stimulus to prices and led to large operations on the part of both the trade and speculators, which caused an advance of 3s. 6d. per cwt., and first products beet, which were quoted at 11s. on the 20th October, were driven up to 14s. 5d. f.o.b. on the 16th November."

Mr. F. O. Licht eventually reduced his estimate to 4,685,000 tons, just about a million tons below what the crop would have produced under ordinary circumstances.

This is what bounties have done by making the sugar prices of the world dependent on the success of the beetroot crop.

PRODUCTION AND CONSUMPTION OF RAW SUGAR, 1897-1905.

We are indebted to the *West India Committee Circular* for the following statistics, which will be found very useful for present and future reference:—

Season 1897-1898.

	Tons.	Consumption.
Visible Supply, 1st October, 1897	1,113,903	
Beet Crop, 1897-98	4,831,774	
Cane ,, ,, ...	2,864,528	
Beet, U.S.	40,399	
	8,850,604	
Deduct Visible Supply, 1st October, 1898	923,224	.. 7,927,380

SEASON 1898-1899.

	Tons.	Consumption.
Visible Supply, 1st October, 1898	923,224	
Beet Crop, 1898-99..	4,982,101	
Cane ,, ,, ...	2,944,545	
Beet, U.S.	32,471	
	8,882,341	
Deduct Visible Supply, 1st October, 1899	949,057	.. 7,933,284

SEASON 1899-1900.

Visible Supply, 1st October, 1899	949,057	
Beet Crop, 1899-1900	5,480,000	
Cane ,, ,, ...	2,856,000	
Beet, U.S.	95,000	
	9,380,057	
Deduct Visible Supply, 1st October, 1900	607,712	.. 8,772,345

SEASON 1900-1901.

Visible Supply, 1st October, 1900	607,712	
Beet Crop, 1900-01..	5,990,080	
Cane ,, ,, ...	3,650,416	
Beet, U.S.	76,859	
	10,325,067	
Deduct Visible Supply, 1st October, 1901	921,562	.. 9,403,505

SEASON 1901-1902.

Visible Supply, 1st October, 1901	921,562	
Beet Crop, 1901-02	6,760,361	
Cane ,, ,, ...	4,027,229	
Beet, U.S.	163,126	
	11,872,278	
Deduct Visible Supply, 1st October, 1902	1,888,312	.. 9,983,966

SEASON 1902-1903.

Visible Supply, 1st October, 1902	1,888,312	
Beet Crop, 1902-03	5,561,257	
Cane ,, ,, ...	4,144,569	
Beet, U.S.	195,463	
	11,789,601	
Deduct Visible Supply, 1st October, 1903 ..	1,879,031	.. 9,910,570

SEASON 1903-1904.

Visible Supply, 1st October, 1903	1,879,031	
Beet Crop, 1903-04	5,864,938	
Cane ,, ,, ...	4,423,800	
Beet, U.S.	210,000	
	12,377,769	
Deduct Visible Supply, 1st October, 1904	1,434,532	.. 10,943,257

SEASON 1904-1905.

	Tons.
Visible Supply, 1st October, 1904	1,434,532
Beet Crop, 1904-05 (estimate)	4,685,000
Cane ,, ,, ,, ...	4,607,000
Beet, U.S. ,, ,, ...	191,000
	10,917,532

PRICE PER CWT. OF 88 BEETROOT SUGAR, F.O.B. HAMBURG, FROM THE GREAT FALL IN 1884 TO THE PRESENT TIME.

	1884.	1885.	1886.	1887.	1888.	1889.	1890.
Average ..	14/-	14/0¼	12/-	11/9	14/-	16/10	12/6¾
Highest ..	18/1½	17/-	15/9	15/6	16/3	28/3	14/3
Lowest	9/9	10/-	10/-	10/6	12/6	11/-	11/6

	1891.	1892.	1893.	1894.	1895.	1896.	1897.
Average ..	13/6	13/7½	15/5¼	11/6¾	9/10½	10/6	8/10¼
Highest ..	14/10½	14/11½	19/-	13/1½	11/1½	12/10½	9/4½
Lowest	12/3	12/5¼	12/2¼	8/6¾	8/5¼	8/7½	8/2¼

	1898.	1899.	1900.	1901.	1902.	1903.	1904.
Average ..	9/5¾	10/0¼	10/5	8/7¾	6/7½	8/2½	10/0
Highest ..	10/3¼	11/5½	12/6½	9/8¾	8/5½	8/6	14/6
Lowest	8/11½	8/11¼	9/1¼	6/6	5/10½	7/7	7/8

	7 Years, 1884-1890.	7 Years. 1891-1897.	7 Years, 1898-1904.	21 Years, 1884-1904.
Average..	14/10½	11/11	9/0¾	11/11½

THE PATENT CIRCULATION EXPRESS VACUUM PAN.

By Geo. Stade, Berlin, C.2.

Introduction.—The general advantages of the Express System having been fully described before,* we need only repeat that for low heads of masse-cuites the Express System gives such a rapid circulation that no other implements are required in order to obtain: (1) a sharp grain sugar; (2) a full economy of heat; (3) the most exhausted molasses without deterioration of the saccharine matter.

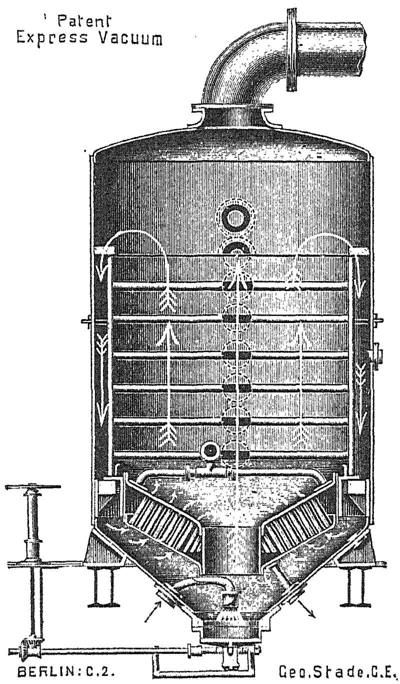
However, circumstances do not always permit large diameter pans with low masse-cuite stands. For instance, in case of increasing the capacity of existing pans by putting up additional shells or in boiling to grain first and second products with a 20 to 40 hours' boiling time, with the object of obtaining coarse grain sugar and waste-molasses in one operation, special circulating appliances had been found absolutely necessary to obtain that rapid circulation which is rightly claimed for a modern pan. Stirring devices can now be entirely disposed of with the new patent circulating arrangement, described below.

This new patent circulating device consists of a system of double or false shells fitted up at certain intervals over the *Express* System, separating the large interior space of the *Express* in such a manner that a forced but natural circulation from inside up to outside down takes place. The false shell is a large tube in sections, and does not come in direct contact with any heating surface. Consequently the whole heating surface of the *Express* can be fully utilised to drive up the masse-cuites without interfering with the masses moving downwards through the space between outside shells and double or false shells.

Principle of Circulation.—The fundamental principle on which this circulation system is based may be explained as follows:—The natural law says that in two communicating tubes filled with liquids of different specific gravities the levels must be of different height. Now, the circulating system contains inside above the Express Heating System a masse-cuite mixed with the vapour generated. Outside, however, between the inner and the outer shells the masse-cuite remains free of any vapour as by action of the vacuum pump the vapour generating from the masses escapes at once to the surface and goes to the condenser. Consequently, the specific gravity of the masse-cuite outside is higher than the specific gravity of the masses above the calandria. This causes the inside masses to overflow over the inner shells. In addition to this circulation, however, the action of the heating tubes of the calandria has to be taken into account.

* Vide *International Sugar Journal*, Vol. V., page 134.

These tubes serve as a powerful suction pump drawing the masse-cuite from the bottom and delivering it through the tubes to the inside tube system, helping in this way to form a strong circulation in the most simple way, doing away with all stirring gear and all movable parts inside the pan. Experiments carried on for a considerable time, and the experience gained in practical work have shown that a mixing of the upward moving masses with the descending masses does not take place at all. Even with thin liquor or water the pan keeps up a forced circuit, the inside and outside masses remaining strictly separate.



On the sides of the double shell the masse-cuite overflows. The down-going masses at the same time (owing to the narrow room between shell and double shell) undergo a certain dislodging of the over-flowing crystals in the surrounding mother liquor, so that the crystals moving down find themselves always in contact with a different and fresh mother liquor. This causes a rapid growth of the crystals on one side while the mother liquor gets quickly and fully drained of all available saccharine matter.

Working of the Pan.—In starting, granulation takes place in the ordinary way with lowest head of liquor, and if required with the smallest quantities also. The circulation will then go on in the same way as in an ordinary *Express* Pan, up through the heating tubes and down through the central tube, and partly along the sides. As soon as the head of the masse-cuite increases so far that the first shell is covered with masse-cuite the circulation starts. On overflowing the circulation proceeds rapidly down between the false shell and the outside shell. Through the spy holes an enormous circulation can be observed, which remains in full force as long as steam is applied to the *Express* System. The discharge can take place in the usual way. After steaming out pan and circulation arrangement the pan is ready for starting again. The whole manipulation has proved so simple and effective that no modern pan should be without this circulation arrangement. To facilitate the boiling of all sugars (but especially low products) a Standard boiling gauge as well as an effective reliable *Express* steam regulating apparatus—no useless reducing valve—are supplied with this new pan as a rule. This enables the pan boiler to keep the masse-cuites always at the right degree of concentration.

By this regulator the steam is kept exactly at the same pressure within $\frac{1}{100}$ of an atmosphere, or say at a limit of 0·15 lbs. per sq. inch. Steam from 0·5 atm. ($7\frac{1}{2}$ lbs.) to 2 atm. (30 lbs.) can be applied by the regulator to the heating surface of the *Express* System.

All kinds of steam can be used with the new circulation pan and a pressure of $\frac{1}{2}$ atmosphere or say $7\frac{1}{2}$ lbs. is sufficient even for large pans with high heads of masse-cuite. The circulations with masse-cuites of viscous and gummy nature—which occurred frequently last crop—was as vivid as could be desired from the beginning up to 5 % of water. With steam of 10 lbs. pressure or say 0·66 atmospheres, careful experiments with a large pan gave an evaporation of 15 lbs. water per square foot heating surface, or say 75 kilogram per square meter. The patentee claims that this evaporation with gummy masses gives results unattained up to date by any other construction, while with the old coils scarcely half that work could be effected.

The unusual occurrence of American refined sugar arriving at Liverpool has lately been chronicled. The high price of sugar induced the Co-operative Wholesale Society to order 160 tons from New York.

The sugar industry of Natal is showing signs of great increase: several large new mills are in contemplation, surpassing in size any yet at work in the Colony, and some big orders for new machinery may ere long be expected by home manufacturers.

SEEDLING AND OTHER CANES IN BARBADOS, 1904.

The Report issued by the Imperial Department of Agriculture on "Seedling and other Canes in Barbados, 1904" is just issued. As in former years we propose to give some extracts from it.

It is noticeable that the compilers are no more elated by the results of this past year than they have been in previous seasons. The same cautious spirit is shown, and we find repeated the statement made in 1900. "It is impossible to draw more than temporary conclusions from one year's work."

The canes were treated in each case, as in former years, in exactly the same manner as the other canes on the estate.

The weather during the season was favourable, and as a consequence the crop was above the average; and the canes suffered very little from the root disease.

"Cane B. 208 has again given uniformly good results both as plant canes and ratoons. A general trial of this cane on a field scale is recommended in all red soil districts. B. 147 has not given as good results this year as in previous years. It is, however, being grown with apparent success in the rather light soils in the parish of St. Philip. One of the newer canes, B. 1,529, heads the list on black soils, and comes second to B. 208 on the red soil list. On account of these very favourable results its cultivation will be extended to as many experimental plots as possible.

"With regard to future work it will be of interest to record that irrigation has been applied to the field on which the seedlings are first planted out. The object is not to grow fine canes by irrigation, but to keep them alive by small applications of water in periods of drought. The irrigation will also enable us to ratoon the stumps so that we can bring each stool to maturity in its first season, and reap it, and form valuable preliminary judgment of its value. We expect in this way to be able to eliminate the greater number of seedlings in the first year, and so save at least two years in forming an opinion of the value of a new variety.

"Another advance in our methods is now being attempted by Mr. L. Lewton-Brain who is making an endeavour, by artificial cross fertilization, to cross known varieties of seedling canes. If this is successful the parentage of each seedling variety will be known, and this may prove of considerable value in the raising of improved varieties."

THE SELECTED VARIETIES ARRANGED IN ORDER OF YIELD, TO SHOW THE RELATIVE POSITION AND PURITY OF JUICE OF CERTAIN CANES IN DIFFERENT SOILS AND ALSO WHEN GROWN AS PLANTS AND RATOONS.

1904.

Variety.	Yield of Saccharose in Pounds per acre.			Purity of Juice.
	Plants.	Ratoons.	Average.	
Black Soils.				
B. 1,529	9,341	...	....	Very high.
B. 208	7,083	4,767	5,925	Very high.
White Transparent	7,068	3,708	5,388	High.
D. 842	6,847	....	....	High.
D. 95	6,769	6,202	6,485	High.
D. 1,438	6,752	...		High.
B. 147	6,659	3,920	5,289	Fair.
B. 376	6,627	3,786	5,206	High.
B. 393	6,590	....	....	High.
B. 645	6,303	3,288	4,795	Fair.
B. 3,233	6,195	....	....	Fair.
B. 1,462	5,794	....	....	Very high.
B. 1,719	5,589	....	....	Very high.
B. 379	4,487	3,369	3,928	High.
White Sport	....	3,527	....	Low.
B. 619	....	2,623	....	Low.
Red Soils.				
B. 208	9,023	5,333	7,178	Very high.
B. 1,529	8,321	....	....	Very high.
B. 376	7,954	6,619	7,286	Low.
B. 393	7,475	2,443	4,959	Low.
B. 379	6,851	6,587	6,719	Low.
White Transparent	6,753	6,045	6,399	High.
Sealy Seedling	6,584	5,351	5,967	Low.
D. 95	6,522	6,743	6,632	High.
B. 390	....	5,173	....	High.
B. 619	....	1,945	....	Fair.
B. 147	....	1,182	....	High.

1900-1904.

Variety.	Yield of Saccharose in Pounds per Acre. Plants.	Ratoons.	Average.	Purity of Juice.
Black Soils.				
B. 208	6,989	3,626	5,307	High.
B. 147	6,941	3,500	5,220	Fair.
White Transparent	6,675	3,040	4,857	High.
Sealy Seedling	6,447	..	..	Low.
B. 376	6,353	..	..	High.
B. 645	5,767	..	..	Fair.
D. 95..	5,157	4,114	4,635	High.
B. 379	..	2,067	..	High.
Red Soils.				
B. 208	7,071	4,762	5,916	Very high.
B. 376	6,386	..	..	Fair.
Sealy Seedling	6,349	..	..	Low.
D. 95..	5,693	5,611	5,652	High.
White Transparent	5,373	4,386	4,879	High.
B. 147	5,090	2,870	3,980	Fair.
B. 379	..	5,557	..	Very high.

Freedom from Rotten Cane.			Germinative Power of Plants.	Germinative Power of Ratoons.
B. 619	·23	Less than average number	Good	Not replanted.
B. 1,529	·34		Fair	Very good.
B. 1,719	·48		Fair	Good.
B. 147	·76		Fair	Fair.
B. 842	·86		Good	Bad.
B. 393	·87		Fair	Good.
D. 95	·96		Good	Good.
D. 1,438	1·18		Fair	Fair.
B. 390	1·47		Not replanted.	
B. 1,462	2·89	average*	Good	Fair.
B. 379	3·30		Good	Good.
B. 645	3·88		Good	Good.
White Transparent	3·94	More than average number	Good	Good.
B. 208	4·56		Good	Good.
B. 376	5·00		Good	Good.
White Sport .. .	5·10		Good	Fair.
B. 3,233	11·66		Good	Bad.
Sealy Seedling ..	12·16		Good	Good.

* The average percentage for the whole series was 3·18.

TABLE IX.

MEAN RESULTS, BLACK AND RED SOIL ESTATES, FOR SEASONS ENDING 1900, 1901, 1902, 1903, 1904.

(Plant Canes.)

Number or Name of Seedling.		Number of Plots.	Canes Tons per acre.	Per cent. by number of Rotten Canes.	Normal Juice. Pounds per gallon. Saccharose.	Normal Juice. Pounds per gallon. Glucose.	Normal Juice. Pounds per gallon. Solids not Sugar.	Normal Juice. Quotient of Purity.	Normal Juice. Glucose Ratio.	Saccharose lb. per acre.	Muscovado Yield.
B. 208	1900	11	22·55	3·70	2·134	·057	·159	90·81	2·67	5,443	1·94
	1901	13	30·22	7·39	2·231	·076	·187	89·40	3·47	8,420	3·01
	1902	12	26·22	5·80	2·312	·065	·146	91·61	2·84	7,595	2·71
	1903	10	20·30	1·42	2·151	·046	·168	90·90	2·19	5,352	1·91
	1904	13	28·08	5·97	2·165	·038	·180	90·81	1·78	7,680	2·74
Mean	.. ..		25·83	5·06	2·201	·057	·168	90·68	2·62	7,014	2·50
B. 147	1900	13	27·52	4·93	1·841	·091	·164	87·83	4·94	6,291	2·25
	1901	18	31·04	5·01	1·906	·108	·197	86·18	5·73	7,684	2·74
	1902	20	27·86	3·91	2·018	·099	·174	88·05	4·95	7,363	2·63
	1903	20	21·90	2·05	1·861	·064	·207	87·06	3·50	5,725	1·83
Mean	.. ..		26·78	3·85	1·913	·090	·187	87·20	4·74	6,618	2·36
White Transparent	1901	9	27·81	10·27	2·050	·090	·153	89·04	4·44	7,320	2·61
	1902	23	24·41	10·27	2·124	·082	·138	90·60	3·88	6,550	2·34
	1903	20	20·52	4·93	1·966	·059	·170	89 52	3·05	5,023	1·79
	1904	27	28·75	4·42	1·930	·060	·177	88·96	3·15	7,010	2·50
Mean	.. ..		25·29	6·92	2·086	·069	·161	89·56	3·47	6,405	2·28
B. 376	1902	5	26·22	11·04	2·157	·074	·103	92·42	3·44	6,947	1·59
	1903	9	21·48	5·36	1·915	·059	·170	89·68	3·15	5,067	1·81
	1904	13	29·69	6·30	1·900	·073	·267	88·64	3·98	7,035	2·51
Mean	.. ..		26·31	6·87	1·952	·068	·158	89·67	3·60	6,363	2·27
Sealy Seedling	1902	8	29·71	4·28	1·992	·100	·226	85·60	5·18	6,942	2·48
	1903	4	23·14	3·82	1·755	·075	·322	80·78	4·39	5,022	1·79
Mean	.. ..		27·52	4·13	1·877	·090	·264	83·67	4·86	6,174	2·21
D. 95	1903	8	17·55	6·65	1·952	·061	·173	89·21	3·20	4,272	1·52
	1904	7	27·05	1·36	1·906	·063	·155	89·71	3·37	6,629	2·37
Mean	.. ..		21·98	4·18	1·930	·062	·164	89·44	3·27	5,371	1·92

Table XII.

MEAN RESULTS, BLACK AND RED SOIL ESTATES, FOR SEASONS ENDING 1901, 1902, 1903, 1904 (Ratoons).

Number or Name of Seedling.	Number of Plots.	Canes, tons per acre.	Per cent. by Number of Rotten Canes.	Normal Juice.					Sacchar-ose, lb per acre.	Musco-vado Yield.
				Pounds per Gallon.			Quotient of Purity.	Glucose Ratio.		
				Saccharose.	Glucose.	Solids not Sugar.				
D. 95, 1903 and 1904 .... mean	8	19·86	3·09	1·888	·058	·166	89·30	3·13	4,862	1·74
B. 376, 1901 to 1904 .. mean	6	18·77	1·13	1·830	·063	·130	89·71	3·42	4,346	1·55
B. 208.. .. .. mean	30	15·41	4·82	2·216	·048	·163	91·56	2·21	4,156	1·48
White Transparent 1902 to 1904 mean	20	14·13	2·81	1·987	·062	·161	89·75	3·21	3,369	1·20
B. 147, 1901 to 1904 .... mean	31	13·15	1·14	1·924	·079	·170	88·40	4·19	3,236	1·15
B. 390, 1903 and 1904 .... mean	8	13·47	1·57	1·934	·049	·190	88·97	2·58	3,081	1·10
B. 379, 1903 and 1904 .... mean	11	14·57	2·55	1·884	·053	·151	89·89	2·88	3,063	1·09

OAXAQUENA PLANTATION SUGAR FACTORY.

"Java," said C. Hedemann, the manager of the famous Honolulu Iron Works Company, and the man who has built or planned a large number of the greatest modern sugar mills in a wide range of sugar producing countries, "is the land where sugar is produced and manufactured according to the most scientific or up-to-date methods. Hawaii also ranks high for the application of scientific principles, and the country where the greatest development in this direction is most immediately forthcoming is unquestionably Mexico."

Mr. Hedemann is at present on the Oaxaquena plantation, in the state of Veracruz, the property of the Tabasco Plantation Company, a corporation with headquarters in Minneapolis. He is studying the ground and making the plans for the erection of a 3,000 ton mill which will be susceptible of increase and which, at least according to ultimate plans, will be the largest sugar mill by far in the republic of Mexico.

Sugar plantations have existed in this country for hundreds of years, and they have in nearly all instances been operated on a paying basis, although the methods of handling the cane and its manufacture have oftened been crude and wasteful in the extreme. The power for the primitive mills was furnished by mules or oxen, and later on small three-roll mills operated by steam power were introduced.

In a great number of the plantations of Mexico to-day the cane is ground by these old-fashioned three-roll mills, although they are not sufficient to extract anything like the full percentage of saccharine matter that may be taken from the cane. Mr. Hedemann's company now erects sugar mill machinery that carries with it a guarantee that it will extract the quite extraordinary quantity of ninety-five and a half of the saccharine matter, although the shipment of such machinery from Honolulu to Mexico is almost prohibitive.

In the majority of cases also old methods are in vogue for the transportation of the cane to the mill and for the handling of the bagasse, or ground cane, after it has passed through the mill. These methods are at the same time relatively much more expensive than the modern way.

The cane is brought in either on the backs of natives or in ox-carts, and the bagasse requires a large force of peon labourers to carry it out of the mill and to spread it on the ground to dry, whence a few days later it must be carted back into the sugar house and thrown into the furnace to burn. The sugar turned out by these mills is not of a very high grade.

Vast improvements have been made in recent years in labour-saving sugar machinery, and a considerable quantity is now finding its way into Mexico. Immense twelve-roller mills are now being planned that have two additional rolls, called "crushers," through which the cane is first passed, and when afterwards it has gone through the four sets of three rollers each, very little saccharine matter is left in the cane. The bagasse is conveyed on an automatic carrier directly to the furnace, furnishing in large mills practically all the fuel that is required to operate the factory.

The methods of transferring the cane from the fields to the mills have also been revolutionized, tramways being laid through the fields and the cane piled upon the cars which are drawn to the mills by steam locomotives.

On arrival at the mills it is taken from the cars by a cane unloader by which it is placed on the cane carrier, whereby it is run upward and forward until it reaches the crusher. This consists of two rollers having zigzag teeth or grooves which work into each other, drawing in the cane, partially crushing and cutting it up into about six inch lengths. After passing through the crusher the mat of cane passes down an iron apron into the first three-roller mill, where it is crushed under a hydraulic pressure on the top roller of 250 tons.

After passing through this mill the cane, having first been sponged with hot water, is carried to the second three-roller mill, operating under a pressure of 320 tons on the top roller. It is then sprayed again and passes to the third mill operated under a pressure of 400 tons on the top roller, and later it goes to the fourth, if there is a fourth, which is not the case so far in Mexico, and in this event the top pressure is nearly 500 tons. The cane refuse, or bagasse is carried by an automatic conveyor to the furnace feeders, whence it is dumped into the furnace as needed.

The juice expressed from the cane is conveyed to an automatic screen apparatus, filled with fines holes, through which it drains into into an immense receiving tank, whence it is pumped up into a juice weighing machine situated over the liming tanks on a level with the vacuum pans. It is then weighed and dropped into the liming tanks to be clarified.

Later the juice is discharged into settling tanks and sufficient time being allowed for impurities to settle out, the clear juice is drawn off into a receiving tank for juice filters. The settlings are diluted with water and after being treated with lime and re-agents, pass to the filter presses by means of which all solids are separated from the clear juice, which is then discharged into the receiving tank over the evaporator.

The evaporator may be of triple or quadruple effect. The first body receives the thin juice and it is operated with exhaust steam

from different engines in the factory. The slightly thickened juice passes from this body into the second, where further evaporation takes place by the use of exhaust steam given off from the juice in the first body. The process continues to the third and fourth effect, each operation being effected with exhaust steam from the previous one, and each one going on under an increasing vacuum, thus requiring less steam to boil the juice, which, in the last body becomes syrup.

The juice which on entering this evaporator contains about 16 per cent. of solid matter, leaves it as syrup containing some 60 per cent. of solid matter. The syrup is now pumped into receiving tanks for the vacuum pans, the thick syrup being thence forced up by independent pumps to immense storage tanks on the vacuum pan floor at such a height as to drain into the pans.

These great vacuum pans which may be from six to ten feet in diameter, and 12 or 15 feet high, are fitted with copper coils containing hundreds of feet of heating surface. These pans are operated under 27 inches of vacuum. The masse-cuite, or cooked body, as it is now called, after being boiled and grained, is dropped into a receiving tank or mixer, and thence into the centrifugal driving machines having baskets three or four feet in diameter lined with brass screens and revolving, when under full speed, at a rate of a thousand revolutions a minute.

The sugar may then be put through a cube machine, and after being cubed is placed in drying ovens, after which it is boxed ready for the warehouse or shipment. For home use in Mexico it is still very commonly kept in granulated form or turned into cones.

A modern sugar mill is usually constructed of steel, and is of a very substantial character. Many miles of tramway lines are laid through the cane fields, and there is required an equipment of several hundred cars as well as a number of steam locomotives.

All these improvements have made it possible to dispense with hundreds of labourers, and have not only increased by manifold the sugar product, but have reduced, in like or greater proportion, the expense of handling and manufacturing it.

In Mexico, even with the old-fashioned and expensive methods, the sugar planters have formed one of the wealthiest classes of citizens, and with the incoming of the vast perfected labour-saving machinery there can be no question that Mexico will loom large in the destinies of the world's sugar production.—*Mexican Herald.*

THE "COLOSO" CENTRAL FACTORY, PORT RICO.

The special interest attached to this enterprise is due, in the first place, to the excellent situation of the sugar industry in general, and more especially to the privileged situation of the sugar industry in Porto Rico since the annexation, for, as everyone knows, all produce of the island enters the United States entirely free.

The sugar cane, for which the climate and soil of Porto Rico are eminently suitable, has always been the most important agricultural product of the island; but the advantages brought about by the change in government promise a further development and a very brilliant future.

In the United States, the duty per ton of raw sugar at 96° is 37·08 dollars, and represents, even at a lower estimate, a bounty to the cane planters of Port Rico of about 56 dollars per acre.

As the United States, with their 80 million inhabitants, represent the largest sugar market in the world, and have, by their enormous consumption of sugar, already made the fortune of certain of their possessions, so one might say that they are now making the fortune of Porto Rico.

These advantageous economic conditions have induced French capitalists to interest themselves in the sugar industry of Porto Rico, and a sucrerie in full working order, and known under the name of the "Centrale Coloso" has recently been purchased on the death of the proprietor.

The central factories are large usines which treat not only their own canes but also those grown over quite a large district, paying for the same either in cash, or, more generally, by a proportion of the sugar produced.

The "Centrale" Coloso" is situated on an estate of 1503 hectares, extending over a fertile and level country, irrigated by two rivers, so that the cane is cultivated under the most favourable conditions. The usine is located centrally, and the property is traversed by a railway, seven kilometres in length, and is close to the port of Aguadilla, where several lines of steamers call, and which thus offers shipping facilities direct to the United States.

Another circumstance, equally favourable, is that the Coloso usine is far removed from all other central factories. The property is situated in the centre of a populous district, divided into the parishes of Moca, Aguada, and Aguadilla, and which, being fertile and level, favours a still greater extension of the culture of the cane.

Consequently, the "Centrale Coloso" is not only able to extend its own lands but can also be supplied with canes from a vast and fertile district.

Hitherto its output has been 30,000 bags of sugar per year, and nothing prevents the output being increased to 100,000 bags, which has been actually reached in several other sucreries in Porto Rico. It was with the object of extending this property that the Société de la Sucrerie Centrale Coloso was formed by a group of capitalists under the auspices of the Crédit Mobilier Français. The capital is 2,750,000 francs, divided into 27,500 shares of 100 francs each. The property of the usine and all its dependencies has been acquired by the Société Anonyme Française for 2,500,000 francs, of which 2,100,000 francs are payable in cash and 400,000 francs in shares, the surplus capital of 250,000 francs being available for current expenses.

The Société was only formed towards the end of the campaign of 1903-4, and its first year of administration will close June 30th, 1905. Already the new Company have added a new mill, and various improved appliances which will enable the output of the usine to reach 50,000 bags, which might be easily doubled by increasing the plant without necessitating any great outlay.

Although the output of the "Centrale Coloso" has been raised to 50,000 bags, the estimated profits are based on the production of 41,000 bags, corresponding to 5,000 tons of sugar. Including the rum crop, which represents an additional profit of at least 8,385 dollars, a comparison of receipts and expenses of the present administration may be stated as follows, according as the market price of sugar is 3·50, 3·75, or 4·00 dollars per quintal.

Price of Sugar per Quintal. Dollars.	Receipts. Dollars.	Expenses. Dollars.	Net Profits. Dollars.	Ratio of Profits of Capital. Per cent.
3·50	338,660	295,343	93,317	17·45
3·75	415,823	295,343	120,480	22·56
4·000	442,985	295,343	147,642	27·65

It will be seen that these returns are very remunerative, but they are not at all exceptional. Moreover, the actual price of sugar in New York is 4·30 dollars per quintal, that is to say, it is actually higher than the highest of those which have been taken for estimating the probable profits. The Société should, therefore, be able to pay a very good dividend.—(*Journal des Fabricants de Sucre.*)

SUGAR BEET GROWING EXPERIMENTS IN GREAT BRITAIN AND IRELAND, 1904, (Tenth Report).

By Sigmund Stein.

(Sugar Expert, Liverpool.)

Although I did everything in my power to publish my tenth report in December last, I was prevented, by pressing business, from doing so, and must therefore ask indulgence.

In this experimental year seed has been sent out to 226 experimentalists, mostly free of charge. From these persons only 173 parcels of roots arrived at my laboratory for analysis. I am sorry that many of them, as in previous years, have not taken the trouble (in spite of my asking them to do so in my circulars) to put their names inside the packages (hampers, cases, baskets, bags, &c.,) and through this omission they could not be identified.

In other instances they did not fill up the forms I sent them to be embodied in my report; many forms have been incomplete; and I can, therefore, only report to-day on 50 experiments of which full details have been given to me, and the roots of which have been identified without doubt. Of these tests there have been 12 in England, 37 in Scotland, and one in Ireland.

In the following tables I leave it for my readers to judge for themselves of the experiments I have carried out for so many years. I do not think there exists anybody, either in this country or abroad, who will say that we cannot grow quite as good beetroots here as on the Continent, richer in saccharine matter than the Continental roots, and having a larger yield per acre. I think I have proved conclusively, and it has been recognised by the highest authorities, that we can easily be our own sugar producers, and cover our home wants by home grown sugar.

As in previous years, I have compared the result of my analyses with the result of Mr. Licht, in Magdeburg, and I give below the comparative results:—

Comparative Results.

	British Roots, 1904.		German Roots, 1904.
Average weight of roots without leaves, in grammes..	892	....	616
Quantity of Sugar in 100 parts of the juice	17·65	....	18·32
Quantity of Non-Sugar in 100 parts of the juice	2·60	....	2·58
Quotient of Purity	87·04	....	87·66

Regarding the quantity of juice and pulp, the average in 1904 was as follows:—

	British.
Juice..	93·26
Pulp	6·74
Total	100·00

In comparing the figures given here for the average in German and British-grown roots, one sees that the result is about the same, but we must pay attention to the figures respecting the weight and the size of the roots. The average weight of the German-grown roots was 616 grammes, but the average weight of the British was 892 grammes; that is to say, the British-grown roots have been about 50 per cent. larger. These figures show that we get more sugar per acre in the United Kingdom than on the Continent.

The experimental year 1904 was an exceptional one, and known as the year of droughts. In spite of the richness in saccharine matter which Continenal roots showed in all countries, the yield per acre was very much smaller. The experiments which have been carried out by the writer during so many years have taken place under greatly differing kinds of seasons. They have been undertaken in years giving abundance of rain and very little sunshine; again, in years which have been excessively dry, as in 1904. Under all circumstances British grown roots came out well, and the trials show repeatedly that our climate, our soil, and our conditions are quite suitable for sugar beet growing. It is astonishing that whereas the yield of roots per acre has been less on the Continent, we can show this year in the United Kingdom a larger yield than in the previous year. The average yield on the Continent in the year 1904 I have calculated at 9·27 tons of roots per acre. But the average yield of British grown roots in the same year was 16·86 tons.

With regard to the tonnage per acre, British grown roots have shown in my results the following yield:—

	Tons.		Tons.
1897	16·07	1901	19·04
1898	16·03	1902	15·90
1899	16·09	1903	14·50
1900	19·01	1904	16·86

A growing interest is being taken in this country to these sugar beet experiments, and many references have been made to them in the Press.

I am constantly asked about my report, and advice is often sought with regard to beet growing and the erection of sugar beet factories. Never in any year has so much interest been taken in these experiments as in the one just past. The reason is to be found in the present situation of the sugar market, with its high prices and shortage of supplies. When the Brussels Convention was signed in March, 1902, it was the intention of the legislators to encourage beet growing in our country. I might refer to the debates on the sugar bounty question in the House of Commons, where many able speakers referred to the growing of sugar beet in the United Kingdom. Influential men keep asking for my advice and are at present considering the question of erecting beet sugar factories.

In giving my advice to those interested parties, I did not promise them the yields and profits of a diamond mine. I pointed out the difficulties of a new industry, the hard work which had to be done as a preliminary, and the careful management which such industrial undertakings required. I, myself, in connection with many influential men, tried, and am trying, to raise the necessary capital for such an undertaking. The capital would be about £100,000, as such a beet sugar factory has to have a certain capacity, and must be provided with sufficient working capital. It would not do to start a new industrial undertaking and find afterwards that the capital was not sufficient, and then have to go and borrow on mortgage or debenture, or seek financial help under very hard and pressing conditions. I tried to get the money subscribed privately, but hitherto have not succeeded in getting sufficient financial support such that I could conscientiously advocate making a start with the undertaking. Beet sugar factories have been started before in England, but under conditions that have not been a safeguard for the future. My efforts are to prevent any such failure in regard to new beet sugar factories. Is it not a pity that we, the bankers of the world, cannot raise privately money to start a beet sugar factory? They who should come forward with the money are the very wealthy landowners. It shows distinctly the feeling people have for British industries, that only since the existing corner in sugar has established itself has the time to realise the scheme arrived. I, however, do not base my calculations on the present unjustifiable abnormal price of sugar. I was very glad to read that one of the greatest sugar authorities in the world said, about three weeks ago, that he regarded the present artificial price of sugar as ridiculous. This gentleman is one of the few who reviewed the sugar question from an independent standpoint. If capitalists think that they could reap benefit by investing in beet sugar factories while sugar remains at the present price, I think they had better invest their money in South Africa. Sugar will go so low in price at the end of this year that a big crash will come and will bury many under its ruin.

The one amongst many schemes mooted that seems to me the best founded is in Ireland. I received, just this morning, a communication from that country which is very promising. I think the Irish question as I have mentioned before, might be helped by the erection of beet sugar factories. The Government have done something in regard to tobacco, which affords to Irish grown tobacco some benefit. Why not do something with sugar? Why not help Irish Farmers, and keep Irishmen in the Emerald Isle? Why drive them out of their country? Labour is plentiful and cheap in Ireland and land and taxes the most favourable in the United Kingdom.

In mentioning the Irish scheme I would not under-estimate the importance of other schemes in the United Kingdom, which have the

laudable object of bringing new work, new enterprises, new occupation, and new investments into existence.

In conclusion I may remark that as new data are forthcoming, I shall publish the analysis of the roots, which are omitted in the present report.

AVERAGES AND RESULTS OF THE EXPERIMENTAL WORK IN SUGAR BEET CULTIVATION.

Table I.—Experiments Carried Out.

Year.	England.	Ireland.	Scotland.	Total.
1897	24	8	4	36
1898	180	39	33	252
1899	62	15	6	83
1900	58	1	36	95
1901	57	4	28	89
1902	31	9	2	42
1903	35	15	2	52
1904	12	37	1	50

Table II.—Average Yield per Acre.

Year.	Tons per acre.	Year.	Tons per acre.
1897	16·07	1901	19·04
1898	16·03	1902	15·90
1899	16·09	1903	14·50
1900	19·01	1904	16·86

Table III.—Analysis of Roots.

Year.	Country.	Average weight of root with leaves, in grammes.	Average weight of root without leaves, in grammes.	Degrees Brix (dry matter).	Specific Gravity.	Quantity of Sugar in 100 parts of the juice.	Quantity of non-Sugar in 100 parts of the juice.	Quotient of Purity.
1897	British	1229	804	18·44	1·076	15·80	2·64	85·64
	German	1148	561	17·81	1·074	15·07	2·74	84·05
1898	British	1371	843	19·05	1·079	16·54	2·51	86·82
	German	974	539	19·02	1·079	16·32	2·70	85·80
1899	British	1644	902	19·00	1·079	16·30	2·70	85·78
	German	957	611	18·30	1·076	15·45	2·85	84·42
1900	British	1525	790	19·52	1·081	17·07	2·45	87·45
	German	1064	557	20·00	1·083	17·38	2·62	86·90
1901	British	1441	851	19·38	1·180	17·02	2·36	87·82
	German	1112	621	17·66	1·073	14·76	2·90	83·53
1902	British	1326	878	19·29	1·080	16·80	2·49	85·11
	German	1042	492	17·43	1·072	14·79	2·64	82·74
1903	British	1516	933	19·93	1·083	17·28	2·65	86·98
	German	1100	560	19·70	1·082	16·87	2·83	85·63
1904	British	1491	892	20·25	1·084	17·65	2·60	87·04
	German	988	616	20·90	1·087	18·32	2·58	87·66

ANALYSIS OF SUGAR BEETROOT.

England.

Reference No.	The Trials were made by	Farming at	What kind of Soil.	What Manure was used, and How much per Acre.	Yield of Roots per Acre in Tons.	Length of time of Vegetation.
						Days
1	Corporation of Liverpool	Walton Sewage Farm	Dark, clay subsoil	Sewage	31·	172
2	,, ,, ..	West Derby Sewage Farm ..	Light loam, sandy subsoil..	,, ...	13·	170
3	,, ,, ..	,, ,, ..	,, ,, ..	,, ...	16·	170
4	,, ,, ..	,, ,, ..	,, ,, ..	,, ...	14·	170
5	Corporation of Northampton	Corporation Farm	Deep loam, gravel subsoil..	,, ...	14·	175
6	Countess of Warwick College	Studley Castle, Warwickshire	Grass land, clay	None	15·	155
7	Lady Isabel Margesson	Foxlydiate, Redditch, Warwickshire	Stiff loam	Stable manure	17·	173
8	John Woolston, Esq., J.P. ..	North Fields Farm, Stamford, Lincolnshire	Medium, clay subsoil......	10 loads of farmyard manure and artificial manure	15·	161
9	Rev E. Muckleston, M.A. ..	Haseley Glebe Farm, Warwickshire	Bogland	None	23·	183
10	Henry Underwood, Esq.	Aughton, Lancashire........	Medium	Farmyard manure and bone manure	19·	171
11	Rossiter Gibbons, Esq.......	Rouse, Guernsey	Sandy	20 loads decaying tomato stalks and leaves and 4 cwt. horn shaving	16·	159
12	Corporation of Liverpool	West Derby Sewage Farm ..	Light loam, sandy subsoil..	Sewage	13·	170
	Average of the Experiments in England.........		....	....	17·25	169
			IRELAND.			
13	Right Hon. Lord Carew	Enniscorthy, Wexford	Light loam, sandy subsoil..	20 tons farmyard manure and 6 cwt. bone manure	22·	188
	Average of the Experiments in Ireland..........		....	....	22·	188

Reference No.	Previous Crop.	Compared with Licht, Magdeburg.				Aderstedt.					Vilmorin.					Breustedt.				
		Average weight in grammes.	Sugar in 100 parts of juice.	Non-Sugar in 100 parts of juice.	Purity.	Average weight in grammes.	Sugar in 100 parts of juice.	Non-Sugar in 100 parts of juice.	Purity.	Sugar in 100 parts of roots.	Average weight in grammes.	Sugar in 100 parts of juice.	Non-Sugar in 100 parts of juice.	Purity.	Sugar in 100 parts of roots.	Average weight in grammes.	Sugar in 100 parts of juice.	Non-Sugar in 100 parts of juice.	Purity.	Sugar in 100 parts of roots.
1	Potatoes	616	18·32	2·58	87·66	914	19·50	2·20	89·86	18·70	..	..	..	..	..	..	..	..	..	..
2	Mangolds	616	18·32	2·58	87·66	848	18·90	3 30	85·30	18·20	..	..	..	..	..	..	..	..	..	..
3	,, ...	616	18·32	2·58	87·66	..	..	..	..	..	923	18·30	2·60	87·56	17·10	..	..	..	..	..
4	,, ...	616	18·32	2·58	87·66	..	..	..	..	..	..	..	..	..	..	1047	17·70	2·90	85·92	16·80
5	,, ...	616	18·32	2·58	87·66	..	..	..	..	..	1182	16·70	2·20	88·35	15·90	..	..	..	..	..
6	Grass	616	18·32	2·58	87·66	..	..	..	..	..	821	17·90	2 40	88·17	16·70	..	..	..	..	..
7	Potatoes	616	18·32	2·58	87·66	..	..	..	..	..	806	16·70	2·70	86·68	15·90	..	..	..	..	..
8	Oats	616	18·32	2·58	87·66	..	..	..	..	..	866	19·30	3·10	86·16	17·70	..	..	..	..	..
9	Sugar beet	616	18·32	2·58	87·66	..	..	..	..	..	1569	17·20	2·20	88·65	16·60	..	..	..	..	..
10	Hay	616	18·32	2·58	87·66	..	..	..	..	..	1124	16·00	2·50	86·48	15·10	..	..	..	..	..
11	Radish..................	616	18·32	2·58	87·66	..	..	..	..	..	..	..	..	..	..	912	17·30	2·40	87·81	16·50
											Braune.					Schreiber.				
12	Mangolds	616	18·32	2·58	87·66	..	..	..	..	..	938	17·90	2·50	87·74	17·10	..	..	..	..	..
Average of the Experiments in England		616	18·32	2·58	87·66	..	..	..	..	..	1003	17·78	2·58	87·39	16·85	..	..	..	..	..
	IRELAND.																			
13	Spring oats	616	18·32	2·58	87·66	..	..	..	..	..	..	..	..	..	..	1426	18·10	3·00	85·78	17·20
Average of the Experiments in Ireland		616	18·32	2·58	87·66	..	..	..	..	..	..	..	..	..	..	1426	18·10	3·00	85·78	17·20

SCOTLAND.

Reference No.	The Trials were made by	Farming at	What kind of Soil.	What Manure was used, and How much per Acre.
14	Right Honourable the Earl of Erroll, K.T.	Home Farm, Stains Castle, Aberdeenshire	Loamy	2 cwt. superphosphate, 1 cwt. bone manure, 1 cwt. sulphate of ammonia, 4 cwt. kainite.
15	West of Scotland Agricultural College	Kilmarnock, Ayrshire	Good loam on hard subsoil	10 tons farmyard manure, 4 cwt. superphosphate, 3 cwt. kainite, 1 cwt. sulphate of soda (applied as top dressing).
16	William Reith, Esq.	Glashmore, Drumoak, Aberdeen.	Light black soil	15 tons farmyard manure.
17	Mrs. Barbara Simmers	Oldtown Leys, Aberdeenshire	Heavy yellow	42 cwt. turnip manure.
18	Alex. Watt, Esq.	Monedie, Mainosh, Banffshire	Sandy loam, gravel subsoil	24 loads farmyard manure, 6 cwt. turnip manure.
19	Messrs. J. & J. R. C. Smith	Galalow, Kelso, Roxburghshire	Medium, gravel subsoil	9 tons farmyard manure, 1 cwt. potash, 1 cwt. nitrate, 5 cwt. superphosphate.
20	Abram Garden, Esq.	Whitemyres Farm, Aberdeenshire	Strong loam, clay subsoil	Horse and cattle manure.
21	Alexander Rankin, Esq.	Roundhillock Farm, Aberdeenshire	Heavy clay	Farmyard manure and dissolved bones.
22	George Cooper, Esq.	Candy Glerach, Drumoak, Aberdeen	Black and hard bottom	16 cartloads farmyard manure.
23	Alex. Leask, Esq.	Haddo Estate, Aberdeenshire	Heath soil, hard subsoil	Potato manure.
24	J. Fraser Smith Esq.	Seafield Estate, Cullen, Banffshire	Light loam	Farmyard manure.
25	Robert Murray, Esq.	Charterhouse, Kelso, Roxburghshire	Medium loam	12 tons farmyard manure, 7 cwt. ground lime, 2 cwt. superphosphate.
26	George Ironside, Esq.	Clofrickford, Auchnagall, Aberdeenshire	Loamy	Potato manure.
27	James Ironside, Esq., M.B., C.M.	Oatyhill Farm, Kincardineshire	Clay soil	13 tons farmyard manure, 3 cwt. turnip manure.
28	Robert S. Mann, Esq.	Bellfield, Countess Wells, Aberdeenshire	Black loamy	40 loads of farmyard manure.
29	Charles Smith, Esq.	Bridgefoot, Aberdeen University Land	Light loam	Farmyard manure and 8 tons superphosphate.
30	Alex. Low, Esq.	Cothill Farm, Aberdeenshire	Free soil, clay subsoil	20 loads farmyard manure, 1½ cwt. sulphate of ammonia.
31	W. Johnston, Esq.	Fintray Mills, Kinaldie, Aberdeenshire	Sandy	Farmyard manure.
32	W. Stewart, Esq.	Earlsfield, Kinnethmont, Aberdeenshire	Loamy	16 tons farmyard manure, 4 cwt. mixed phosphate and potash.
33	James Strachan, Esq.	White Bruntland, Portlethen, Kincardineshire	Black soil	3 cwt. superphosphate, 1 cwt. sulphate of ammonia, 20 tons farmyard manure.

Reference No.	Yield of Roots per Acre (Tons).	Length of time of Vegetation.	Previous Crop.	Compared with Licht, Magdeburg. Average weight in grammes.	Sugar in 100 parts of juice.	Non-Sugar in 100 parts of juice.	Purity.	Klein Wanzleben. Average Weight in grammes.	Sugar in 100 parts of juice.	Non-Sugar in 100 parts of juice.	Purity.	Sugar in 100 parts of roots.
14	8	Days. 152	Corn	616	18·32	2·58	87·66	979	19·30	2·40	88·94	18·00
15	9	178	Potatoes	616	18·32	2·58	87·66	893	18·20	2·40	88·35	17·10
16	26	167	,,	616	18·32	2·58	87·66	771	16·20	2·40	87·09	15·60
17	14	150	Corn	616	18·32	2·58	87·66	587	17·30	2·50	87·37	16·30
18	12	172	,,	616	18·32	2·58	87·66	972	16·60	3·10	84·26	15·80
19	23	173	Oats	616	18·32	2·58	87·66	919	17·10	2·70	86·36	16·50
20	19	184	,,	616	18·32	2·58	87·66	1131	18·30	2·40	88·40	17·60
21	17	157	,,	616	18·32	2·58	87·66	947	14·70	2·60	84·85	14·00
22	14	160	,,	616	18·32	2·58	87·66	1010	16·70	2·20	83·06	16·10
23	10	175	,,	616	18·32	2·58	87·66	556	20·00	2·40	89·29	18·20
24	17	196	Cabbage	616	18·32	2·58	87·66	929	14·20	2·60	84·52	13·60
25	12	165	Oats	616	18·32	2·58	87·66	911	15·90	2·50	86·41	15·00
26	18	156	Potatoes	616	18·32	2·58	87·66	771	18·00	2·20	89·10	17·20
27	36	173	Beans	616	18·32	2·58	87·66	1144	18·90	2·90	86·69	18·10
28	18	166	Oats	616	18·32	2·58	87·66	817	19·50	2·20	89·86	18·00
29	10	173	,,	616	18·32	2·58	87·66	581	17·30	2·30	88·20	16·70
30	10	195	,,	616	18·32	2·58	87·66	1929	15·80	2·10	88·26	15·10
31	18	164	,,	616	18·32	2·58	87·66	927	19·20	2·60	87·61	17·90
32	16	156	,,	616	18·32	2·58	87·66	717	17·90	2·40	88·17	17·10
33	8	148	,,	616	18·32	2·58	87·66	811	16·70	2·70	86·08	15·80

SCOTLAND.—*Continued.*

Reference No.	The Trials were made by	Farming at	What kind of Soil.	What Manure was used, and How much per Acre.
34	James Watt, Esq.	Lyne of Skene, Aberdeenshire	Moss	20 tons farmyard manure
35	W. Mitchell, Esq.	Caies Mills Farm, Kinaldie, Aberdeenshire	Light loam	Farmyard manure
36	James Taylor, Esq.	Clofrickford, Auchnagatt, Aberdeenshire	Loamy	20 tons horse manure and 7 cwt. ground lime
37	Joseph Massie, Esq.	Torry Farm, Essement Estate, Aberdeenshire	Heavy loam, clay subsoil	4 cwt. superphosphate, 15 tons farmyard manure
39	W. Wright, Esq.	Bellfield Farm, Balgownie Estate, Aberdeenshire	Dark loam	25 tons farmyard manure
39	W. S. Wilson, Esq.	Main of Scotstown, Bridge of Don, Aberdeenshire	Loamy	20 tons farmyard manure
40	Alex. Johnston, Esq	Feterangus, Mintlaw, Aberdeenshire	Sandy loam	Farmyard manure
41	James Barclay, Esq.	Farburn, Fintrao, Aberdeenshire	Moss, clay subsoil	Farmyard manure and 4 cwt. turnip manure
42	W. Halley, Esq.	Mannofield, Aberdeenshire	Black clay subsoil	Stable manure
43	W. Cruikshaw, Esq.	Cortes Gardens, Lonmay, Aberdeenshire	Loamy on gravel	10 tons farmyard manure, 1 cwt. sulphate of ammonia
44	John Leonard, Esq.	Mintlaw, Pitfour Estate, Aberdeenshire	Strong loam	Farmyard manure and potatoe manure
45	James Fowlie, Esq.	Brucehill, Newdeer, Aberdeenshire	Black deep loam	Bone dust and slag
46	Alex. Alcock, Esq.	South Fordtown, Kintore, Aberdeenshire	Black mould	Farmyard manure
47	James Findlay, Esq.	Croighaid, Kinkardine	Light loam	20 tons farmyard manure
48	G. R. Grant, Esq.	Auchnacree, Brechin, Forfarshire	Light loam	10 tons farmyard manure, 6 cwt. basic slag, ½ cwt. nitrate of soda, 2 cwt. sulphate of potash
49	George Davidson, Esq.	Whiterashes Farm, Aberdeenshire	Mould, light subsoil	Bone and stable manure
50	Joseph Ruxton, Esq.	Tyacksnook, Lonmay, Aberdeenshire	Loamy sandy subsoil	Farmyard manure and dissolved bones

Reference No.	Yield of Roots per Acre (Tons).	Length of time of Vegetation.	Previous Crop.	Compared with Licht, Magdeburg. Average weight in grammes.	Sugar in 100 parts of juice.	Non-Sugar in 100 parts of juice.	Purity.	Klein Wanzleben. Average weight in grammes.	Sugar in 100 parts of juice.	Non-Sugar in 100 parts of juice.	Purity.	Sugar in 100 parts of roots.
		Days.										
34	24	183	Turnips	616	18·32	2·58	87·66	947	14·20	2·10	87·11	13 70
35	10	164	Oats	616	18·32	2·58	87·66	688	17·60	2·90	85·85	16·70
36	24	156	Potatoes	616	18·32	2·58	87·66	719	18·40	2·30	88·88	17·00
37	19	137	Oats	616	18·32	2·58	87·66	911	16·80	3·20	84·00	16·00
38	12	174	Corn	616	18·32	2·58	87-66	613	18·50	2·90	86·44	18·00
39	10	173	Potatoes	616	18·32	2·58	87·66	839	17·70	2·70	86·76	16·80
40	30	171	,,	616	18·32	2·58	87·66	491	18·40	2·20	89·32	17·60
41	17	145	Corn	616	18·32	2·58	87·66	721	16·40	2·50	86·77	15·80
42	9	149	Peas	616	18·32	2·58	87·66	813	19 00	2·60	87·96	18·10
43	16	191	Turnips	616	18·32	2·58	87·66	951	19·60	3 10	86·34	18·10
44	17	154	Oats	616	18·32	2·58	87·66	615	16·50	2·70	85·94	15·40
45	19	177	Potatoes	616	18·32	2·58	87·66	801	17·60	2·20	88·88	16·80
46	16	184	Carrots	616	18·32	2·58	87 66	982	17·90	2·90	86·06	16·80
47	25	185	Potatoes	616	18·32	2·58	87·66	882	19·20	3·10	86·34	18·00
48	15	158	Barley	616	18·32	2·58	87·66	792	18·70	3·70	83·48	18·00
49	17	173	Grain	616	18·32	2·58	87·66	779	18·20	2·70	87·08	17·40
50	19	182	,,	616	18 32	2·58	87·66	1126	18·40	2·70	87·20	16·90

	Yield of Roots per Acre (Tons).	Length of time of Vegetation.	Average weight in grammes.	Sugar in 100 parts of juice.	Non-Sugar in 100 parts of juice.	Purity.	Sugar in 100 parts of roots.
		Days.					
Average of the 37 Experiments in Scotland	16·59	168	840	17·59	2·60	86·94	16·67
Average of the 50 Experiments in the United Kingdom in the year 1904	16·86	169	892	17·65	2·61	87·04	16·73
Compared with German grown roots according to Mr. Licht, Magdeburg, in the year 1904	..	..	616	18·32	2·58	87·66	..

THE PRESENT EXTENT OF OUR KNOWLEDGE OF DIFFUSION LOSSES.

(Continued from page 43.)

In the case of freshly charged diffusers, it might be supposed that the activity of bacteria would result in the destruction of a considerable quantity of sugar in a very short time, but this is not found to be the case in practice. Although such activity is capable of detection, it is, on the other hand, much more easy to detect the products of transformation resulting from bacterial growth. One of these is invert sugar,—but it has been already proved that only a very slight increase occurs during diffusion; another is acidity,—but up to the present no increase in the acidity of diffusion juice has been observed in German sucreries, nor during the researches at Dormagen, which extended over several years; finally it is known that bacteria produce gelatinous masses and also gases. A simple calculation will show how considerable these effects should be if, for example, 1% of sugar be destroyed during the diffusion. Suppose a battery composed of eight diffusers of 5 cubic metres capacity each, and therefore containing 3000 kilos. of beet slices, and that each circuit of the battery is made in two hours. Then, during this time 24,000 kilos. of roots would be worked, and 240 kilos. of the contained sugar would be destroyed. As stated above, 1 kilo. of Leuconostoc requires about 600 grams of sugar for its development. In two hours there would therefore be formed $\frac{240}{0{\cdot}6} = 400$ kilos. of the Leuconostoc bacteria, or 50 kilos. in each diffuser, a quantity which would certainly be noticeable. Again, suppose the 240 kilos. of sugar were completely fermented with the production of carbonic acid and alcohol; then, as 100 parts of sugar yield 51·5 parts of carbonic acid, 240 kilos. of sugar would yield 124 kilos. of acid. As a cubic metre of this gas weighs about 1·80 kilos. at 19·5 c. the 240 kilos. of sugar, by fermentation, would yield about 70 cubic metres of gas, namely, a volume nearly double the capacity of one diffuser, and which could not remain unobserved. The volume of gas will be still greater if the bacteria present are such as do not ferment, but oxidize the sugar. But the formation of even one-tenth of the above mentioned volume of gas has never occurred in practice, under the most favourable conditions. It remains only to point out that the influence of microorganisms on infected juice is much less powerful and rapid than is generally supposed. I am of opinion that the destruction of sugar by their agency does not occur during diffusion, but only when the juice remains for a considerable time, in the measuring tanks and re-heaters. Experiments, published some time ago in the *Centralblatt*, indicate

that diffusion juice, drawn from the sampling-cock on the last day of the season, could be kept for one or two hours without any appreciable loss of sugar, although the juice must have been strongly infected owing to the fact that the juice-cock and measuring tank had not been cleansed. Grundmann observed still more striking instances in which diffusion juice remained undecomposed for six hours, and in one case for sixty-four hours. These facts prove that the destructive power of the organisms present is only appreciable after some lapse of time.

Those who maintain that considerable and unexplained losses occur during diffusion, have long been fully aware that micro-organisms, notwithstanding all that has been said about their activity, are not the actual causes of such losses. They have, therefore, been obliged to resort to the less familiar actions of enzymes and diastase, and especially to those products of bacterial life which cause inversion, fermentation, and oxidation, effects which are more generally attributed to micro-organisms themselves. But inasmuch as such agencies have been very little studied, it is easy enough to attribute the destruction of sugar during diffusion to causes so uncertain. But since enzymes produces the same effect as micro-organisms, namely, inversion, fermentation, and oxidation, the facts already mentioned would prove that the destruction of sugar through the agency of enzymes does not occur. Moreover, the properties of enzymes, and their behaviour under different influences, do not support the theory that the destruction of sugar through diffusion is due to their influence rather than to micro-organisms. But as much obscurity still exists as to the properties, behaviour, and effects of enzymes, it may be well to enter into some explanations. Enzymes, or soluble ferments, are organic compounds, probably analogous to albuminoid compounds, and which can be extracted from the cell. They possess the property of bringing about certain chemical changes without taking part in the process themselves. Amongst the enzymes which decompose sugar may be mentioned sucrose, or invertin, which inverts sugar; zymase which ferments the invert sugar thus formed, and possibly also the oxidases which oxidize sugar without previous inversion. Only minute quantities of these enzymes are brought into the solutions treated in the factory by the micro-organisms living in the juice. The invertin remains in the cell so long as the surrounding liquid contains sugar, and only commences to diffuse when the liquid no longer contains sugar. The beet-cells, on the contrary, contain invertase and zymase, both of which were isolated by Stoklasa some time ago, and previously by Gonnermann, when their existence accounted for the decomposition of beetroots in the absence of air. Invertin is regarded as one of the most active enzymes; 1 gram being sufficient to invert 4,000 grams of sucrose, but the action is relatively slow. If a 10% solution of sucrose is

brought into contact with 1 c.c. of invert at 50° C. there are obtained only 0·2% of invert sugar after one hour, and 0·4% after two hours. The temperature at which invertin acts most rapidly varies from 50° to 56° C. according to different observers. The invertive action is very sensibly weakened at temperatures above 56° C., and between 65° and 70° C. the enzyme is completely destroyed. A slight acidity is favourable to the action of invertin; a strong acidity or a strong alkalinity is very prejudicial. Zymase is most active at a rather low temperature; according to Buchner at 22° C., or to other authorities at 30° C., and is coagulated at temperatures between 38° and 40° C. A solution of zymase heated to certain temperature (according to some 35°-40°, to others 40°-50° C.) becomes turbid by coagulation, and loses its activity. From these properties of invertin and zymase, it follows that, during diffusion, both enzymes are subjected to less favourable conditions for the destruction of sugar and are more easily destroyed than micro-organisms. Moreover, as they are only found in very small quantities in the juice, and act very slowly, it is quite impossible that they should destroy more than traces of sugar.

There remains only the question of the influence of oxidases, which are always present in beetroot, and cause the beet-slices and the juice to darken on contact with air. The existence of oxidases capable of acting on sugar has not so far been proved. Should such a species be discovered in the juice, it would presumably act like all other enzymes, that is to say, very gradually, as is observed in the case of enzymes which act on the colouring matter of the beetroot. An active destruction of sugar, during the brief period of time in which the beets are passed through the slicers, is therefore most improbable, being opposed to all that we know of the characters and effects of enzymes. In the interior of the diffusion battery, the oxidases are naturally rendered inactive by the absence of oxygen.

By the foregoing explanations, I hope to have proved that the undetermined losses during diffusion are very small under normal conditions. With faulty working, such as retarded diffusion and too low a temperature (which should only occur when the battery work is interrupted, or in particularly unfavourable circumstances),—when infected water is employed in the battery, or when the roots are insufficiently cleaned,—the activity of micro-organisms may certainly account for a loss of sugar which may amount to 0·1 to 0·2% of the mean sucrose-content of the roots. In any case, experiments made at Dormagen last season indicate that, even under such conditions, the losses are only small. For example, a constant evolution of gas in the terminal diffuser occurred during several weeks, but the total and undetermined losses did not differ from those obtained during another period in which no gas was formed. Much more gas was observed during the previous season but the losses were even lower

than in other seasons; the total being $1\frac{1}{4}$ instead of $1\frac{1}{2}\%$, and the undetermined loss 0·55 instead of from 0·75 to 0·85%. Under such abnormal conditions as result in the formation of gas and frothing of the juice, it should be quite exceptional for the losses to amount to 1 or $1\frac{1}{2}\%$. These conclusions are confirmed by determining the losses by methods which indicate the total quantity of sugar contained in the roots. It may be admitted with certainty that in every sucrerie, where the losses are determined by exact methods, identical results will be obtained. In conclusion, therefore, we will briefly outline the necessary conditions for an exact determination of losses during diffusion.

The quantity of roots treated should be determined by weight, and an average sample of the fresh slices analysed by the method of hot water digestion, which indicates the total quantity of sugar with the greatest speed and accuracy. Average samples of the whole of the spent-slices should also be drawn and analysed. The weight of spent-slices should not only be indirectly estimated by means of average data, but these latter should be constantly checked by direct determinations by weight and by volume. In determining the loss due to incomplete extractions it is specially advisable to weigh the spent-slices. The diffusion juice should be accurately measured, which is impossible when the re-heaters are of the open type, and necessitates special measuring tanks. The analysis of the diffusion juice should be carried out on a perfectly fresh sample, which must be analysed immediately. If determined in this manner, it will be found that losses amounting to 1 and $1\frac{1}{2}\%$ of the total sugar in the roots cannot occur during diffusion without detection, but that the sugar present in the roots will be accounted for in the diffusion juice and spent-slices, to within one or two-tenths per cent.; that is to say, within the limits of errors in analysis.

Discussion being invited, M. Niessen read a letter he had just received from M. Raschkowitz, relating to the latter's researches on this subject. In his opinion it is not possible that 1% of sugar should be lost in the battery, but a careful account should be kept of losses. It is known that bacteria cause losses, but this question still requires elucidation by numerous researches. In a recently charged diffuser he had found about two million bacteria per cubic centimetre of juice, and even in the new terminal diffuser, from 1,540,000 to 1,910,000. The organisms had therefore multiplied considerably in the diffuser. Only 2000 bacteria were found in the second diffuser at a temperature of 71 C., so that the temperature exercises considerable influence. Raschkowitz went still further, and found bacteria in the measuring tank in the following proportion per cubic centimetre of juice:—

"Meichage" juice	1,240,000 and	1,200,000
Diffusion juice (before displacement)	1,780,000 ,,	1,440,000
Measuring tank	2,120,000 ,,	1,580,000
Terminal diffuser (at 70 C.)	1,600 ,,	1,800

These figures diminish considerably when pure water was employed in the battery. For example, in a sucrerie which drew its water supply from an artesian well, only 100 bacteria were found in the terminal diffuser. On the occasion of a Conference at Kiew, M. Raschkowitz exhibited 42 pure cultures of the bacteria in question, although indicating that his researches were not yet completed. At the same time he showed that, among these 42 varieties, there were only six which had any action upon sugar, some destroying it completely, whilst others inverted it. The lecturer had previously mentioned that the Leuconostoc Mesenteroides was one of the most objectionable varieties, but M. Raschkowitz had proved the existence of much more harmful germs, which attain their maximum activity at a more elevated temperature, and which could exist and even multiply at temperatures of from 60° to 70° C. In order to prove the rapidity of their action before the Conference at Kiew, some of these bacteria were introduced into a pure solution of sugar. At the close of his lecture, which lasted scarcely an hour, the gas liberated from the solution was measured in a burette and found to amount to 80 cubic centimetres. At all events, the matter was clear to any fabricant. M. Raschkowitz affirmed that although only the bacteria had any great influence, it was also necessary to consider the influence of oxidases during the course of manufacture. According to M. Hermann, it had not yet been proved that these destroy sugar, but he was probably unaware of a new work, published in Russian, by the Technical Institute of St. Petersburg, in which it is proved that oxidases destroy sugar in very large quantities.

The lecturer had expressed surprise at the formation of large quantities of gas at Dormagen last season. Decomposition of sugar must therefore have occurred, but possibly the determination of losses had not been sufficiently exact owing to the many difficulties attending such work. He attributed the errors to the determination of the weight of roots by means of Hennefer's automatic balance. What deductions were made for moisture, leaves, &c.? How much soil would be found on the balance, even when the latter was thoroughly cleaned? Some allowed 1%, others perhaps 2%; but these differences ought to be taken into consideration. He proceeded to explain how he had been invited by an inventor—who had a new method of destroying bacteria during diffusion—to assist in some experiments in a German sucrerie. The director of the latter did not consider that his battery work was satisfactory, but placed it at our disposal since the experiment would cost him nothing. As soon as

the third diffuser had been treated, the battery appeared to work much better than before, requiring only four minutes per diffuser instead of six. Moreover, the juice became clear and of good colour, and the frothing in the measuring tanks and re-heaters had disappeared. The result appeared perfect, but the inventor was less satisfied two hours later, when, on examining samples taken from the battery, he soon recognised that things were going wrong. After three hours, the work had to be interrupted, because in place of the bacteria destroyed by the process, the latter had had no retarding influence on those of an entirely different kind, which produce sulphuretted hydrogen in the battery with most disagreeable results. Fortunately, he was able to destroy these new bacteria by the addition of carbolic acid, and, three hours later, the customary method of working was resumed and the juice again became cloudy as before. Here, then, was a striking instance of the influence of bacteria. On another occasion the speaker visited a sucrerie where very dirty roots were being worked, and the amount of gas formed in the battery would hardly be credited. When, by his advice, the work was resumed with other and cleaner roots, the battery work became regular and quite satisfactory at the end of an hour. Subsequently, the fabricant had all the soiled roots placed on one side in order to avoid a repetition of this trouble. Such facts clearly prove that the influence of bacteria in the sucrerie calls for the closest attention.

Professor Herzfeld then spoke, expressing his agreement with M. Hermann's views, with a few exceptions. It must unfortunately be admitted that data relating to known, or provable, losses are only reliable where the diffusion is conducted with the greatest care and under such favourable conditions as are rarely met with in sucreries. It is for this reason that it appears very desirable to still further improve the diffusion process or to replace it by some other.

Regarding the experiments of M. Raschkowitz, in which the bacteria, or rather the micro-organisms, were counted, one might well ask why similar researches have not been made in Germany, seeing that various works have appeared on the subject, amongst which may be mentioned those of Dr. Schone. A simple explanation is that nothing can be deduced from approximate numbers of this kind. The organisms differ widely and, according to Professor Zeltnow, it is necessary to distinguish between bacteria and fungi. It is not yet proved that bacteria are directly harmful, whereas fungi are known to secrete enzymes which invert and destroy raw sugar. Moreover, there exist two kinds of moulds (mucors and penicillium) which produce invertin. We, also, have made experiments on the decomposition of sugar by bacteria, which are easy but prove nothing, such favourable conditions as are then insured being absent in actual practice. The Leuconostoc Mesenteroides has always proved with us the most active of the fungi, but whether it really is so has again

become doubtful. Zopf has studied this question and shown that all fungi are destroyed at a temperature of 65°C. for example, with the exception of the Leuconostoc. But among the numerous cases which had come under the speaker's notice, and which had been examined with care, he had not found a true Leuconostoc; the latter also being destroyed at a temperature of 65°C. M. Niessen had referred to the "high-temperature" bacteria of Dr. Raschkowitz. If these are able to live, they are probably not harmful. The speaker then briefly alluded to enzymes. As is well-known, all the products of plant-life may be traced to the actions of enzymes, and many of these have been prepared in a pure state. But all enzymes die in the absence of albumen, and moreover they only act at low temperatures. Those of an hygroscopic nature are the most important but it is doubtful whether they can be isolated. Under favourable conditions it is known that fungi destroy sugar, but this depends entirely on the quantity present. He agreed with M. Niessen that we cannot, with the greatest care, prevent the formation of enzymes, but at the same time we must not exaggerate their danger. As regards the sucreries, it is highly desirable to adopt more perfect methods of control.

Dr. Claassen promised to be brief, Prof. Hertzfeld having referred to most of the points on which he had intended to speak; he would confine his remarks to a few practical points. Bacteria and enzymes give rise to the formation of gas, of frothing, acidity, &c., which cannot remain ignored by the practical man. At Dormagen the acidity of the diffusion juice had been recorded for many years, and they had never met with appreciable losses. The formation of gas in the terminal diffuser is generally accompanied by increased acidity of the juice, but this proof of the activity of bacteria or enzymes is not, as a rule, brought forward. Every sucrerie contending with this difficulty should therefore be advised to determine the acidity of the diffusion juice at regular intervals. Up to the present only the formation of hydrogen gas has been proved; carbonic acid gas having never been observed, except in minute quantities, arising from the cellular tissues of the beetroots. The formation of hydrogen may, it is true, be attributed to the organisms of the soil passing into the battery, and able to withstand the temperature, and becoming very active at the low temperature of the last diffuser. A volume of 50 litres of gas has already been met with at Dormagen, but this corresponds to the destruction of a very small quantity of sugar. When working roots which give rise to gas during diffusion, the number of diffusers in the battery should be reduced. In this case the work can be somewhat hastened, whereas in a long battery a frothing mass forms in the diffusers and is the cause of trouble.

Dr. Zscheye, of Biendorf, thought that micro-organisms are not in the least objectionable in normal working, and that it is we who are to blame in the case of abnormal juice. The formation of gas

occurs when the beet-slices are pulpy and form a sediment, which interferes with the distribution of heat throughout the diffuser. If the slices are properly cut, no sediment is formed and, consequently, the special phenomena disappear. The frothing of the juice is due to the diffuser being overheated. Consequently, as soon as the formation of froth or of gas is observed, the knives of the slicing machine should be immediately renewed, so as to obtain perfect slices without pulp, and all difficulties will disappear. It was certainly going too far to attribute all defects to living organisms, for if these are present in the number stated, a solution of invert sugar and salts would be the only result of diffusion.

M. Neissen agreed with Prof. Herzfeld's remarks concerning the number of organisms. He had, however, cultivated bacteria which destroy sugar.

Dr. Claassen had admitted that he had known cases where the formation of gas could not be accounted for. Although the formation of carbonic acid in the battery was not yet proved, the presence of hydrogen had already been frequently established. To produce a flame ½m. in length, as reported by Dr. Claassen, a certain quantity of this gas must have been present, but he did not think that 50 litres of gas would account for the loss of sugar. He supposed that a decomposition of sugar occurs, and that every effort should be made to prevent the formation of gas. With this object, Dr. Claassen had advised the reduction of the number of diffusers in the battery, but he doubted whether this would be effective in all cases. Dr. Zscheye was wrong in supposing that bacteria are rendered inactive at a temperature of 70° C. As a matter of fact, the effect of over-heating is to produce more frothing, but this is not due to bacteria. Frothing occurs in every sucrerie, especially in the measuring tanks, but only once in his experience, namely, that reported above as occurring in a German sucrerie, had he noticed the disappearance of frothing on the destruction of bacteria.

Professor Herzfeld then explained that hydrogen was formed not only by the action of bacteria, but that the latter always produce lactic or acetic acids, which immediately attack the iron of the containing vessels, thus giving rise to this gas All carefully conducted experiments confirm this view. The reduction of the length of the battery had very beneficial effects in such a case.

M. Bosse, of Hecklingen, maintained that Dr. Zscheye was right in stating that well cut slices were essential to good work in the battery. He held that the diffusion should be as rapid as possible, and that the slices ought to be brought into contact with the hot juice without delay. The temperature of the first or second diffuser should be brought to 60° to 75° C. which destroys the germs, and there would then be nothing to fear. The temperature should be raised in

such a manner that the slices do not commence to soften. The main thing is to see that the slices are properly prepared.

Dr. Schone had found bacteria which produce mucous, and he had determined the dextrine formed by these bacteria by polarization, and found a dextro-rotary power. It was therefore quite possible that these substances masked the true losses when the juice was polarised. He had also found bacteria analogous to those found in the intestines, amongst which the Coli bacillus yields gases (hydrogen, sulphuretted hydrogen, &c.). As regards the effect of heat on bacteria, he need only mention that bacteria exist which only attain their maximum activity at 70 C. Dextrine gives rise to frothing as in the case of the Leuconostoc, and the presence of this organism might perhaps explain why considerable losses of sugar had not been determined.

Dr. Herzfeld asked Dr. Schone whether the Coli bacillus produced Invertin, to which the latter replied in the affirmative.

Dr. Winter wished to correct an error that appeared in many works; the Leuconostoc did not form dextrin at all; this substance could not therefore conceal any loss. The gelatinous masses which sometimes form consist of a substance resembling cellulose, and which, by the action of alkalies, yields dextrin; but that gelatinous mass is completely insoluble in water.

Dr. Schone remarked that in different tests he had found soluble mucous. It was only a supposition on his part that the losses might be thus masked. A large number of bacteria also produced alkalis, which might thus neutralise the acids.

Dr. Claassen observed that the cause of the formation of gas is still very obscure. The production of hydrogen must depend upon some particular condition of the beetroots, inasmuch as the quantity of adhering soil is always more or less the same, so that if this is the cause, the formation of gas would be observed every year.

M. Niessen remarked that Dr. Schone had proved that certain bacteria produce hydrogen directly. As regards the inversion when hydrogen is formed, he supposed that certain bacteria completely destroyed sugar, whilst others only inverted it. There still remained the question whether the beetroots were the cause; it would also be probable that the bacteria would develop better in the case of diseased roots.

Dr. Claassen stated further that the formation of 900 litres of gas in a diffuser under the conditions mentioned would correspond to barely 0·1% of sugar destroyed, and a volume of 50 litres to 0·005%.

The discussion was closed by the President thanking Dr. Hermann for his lecture, which had led to a very interesting discussion.—(From the *Centralblatt fur die Zucker-Industrie.*)

MONTHLY LIST OF PATENTS.

Communicated by Mr. W. P. THOMPSON, C.E., F.C.S., M.I.M.E., Chartered Patent Agent, 6, Lord Street, Liverpool ; and 322, High Holborn, London.

ENGLISH.—APPLICATIONS.

27289. A. KOLLREPP & A. WOHL, London. *Improvements in and relating to the purification of sugar solutions.* (Date applied for under Patents' Act, 1901, 16th December, 1903, being date of application in Germany.) (Complete specification.) 14th December, 1904.

28321. G. H. MANN, Gloucester. *A combined sugar scuttle and automatic water sifter.* 27th December, 1904.

28534. A. HORN, London. *New or improved machine for pulling and doubling boiled sugar in a semi-fluid state.* (Complete specification.) 28th December, 1904.

28620. P. HAASE, London. *Improvements in and relating to sugar and similar machinery.* 28th December, 1904.

28800. H. H. LAKE. London. (Communicated by the Walter M. Lowney Company, United States.) *Improvements relating to the manufacture of chocolate confections.* (Complete specifications.) 29th December, 1904.

ABRIDGMENTS.

28617. R. HARVEY, London. *Improvements in and relating to evaporators for the treatment and concentration of cane juice, beet juice, and other juices and liquids.* 30th December, 1903. This invention has reference to improvements in and relating to the construction and method of working evaporators of the single or multiple effect type for treating and concentrating cane, beet, or other like juices or liquids, the action being that of a combined heater and film evaporator, wherein there is no circulating current or down-pipe or passage, but each tube in the calandria acts independently as a heater film evaporator.

27666. R. HARVEY, Glasgow. (Communicated by L. Naudet, Paris, France, and H. C. Hinton, Maderia.) *Improvements in and relating to the treatment of sugar cane, beetroot, and the like.* 17th December, 1903. This invention relates to the method of treating raw cane juice or other juices of the cane, beetroot, or like plants after these have been broken up, consisting in subjecting such juices to forced filtration, combined with the maceration of the megasse or like material from which the juice is extracted.

27763. J. W. MACFARLANE, Kingston, Glasgow, N.B. *Improvements in centrifugal machines.* 18th December, 1903. This invention relates to a centrifugal machine, interlocking devices arranged between the parts so that the operations of purging, liquoring, washing, or steaming can only be performed in a predetermined sequence.

28296. E. SHAW, London, England. *Improvements in the treatment or preparation of sugar.* 24th December, 1903. This invention relates to the production of sugar, the preparation and use of a solution of the sugar under treatment and a definite proportion of invert sugar, with the object of producing sugar containing predetermined proportions of sugar, invert sugar and water, and thereby imparting to the sugar the characteristic properties desired.

28297. E. SHAW, London, England. *Improvements in the treatment or preparation of sugar.* 24th December, 1903. This invention relates to the production of sugars, the preparation and use of a solution of the raw sugar juice under treatment, and a definite proportion of invert sugar, with the object of producing sugar containing predetermined proportions of sugar, invert sugar and water, and thereby imparting to the sugar the characteristic properties desired.

28711. R. HARVEY, London. *Improvements in and relating to evaporators for concentrating sugar cane, beet, and like juices or liquids.* 31st December, 1903. This invention relates to an evaporator having three tube plates, with a juice space between the intermediate and lower plates, and having inner tubes with closed top ends between lower plate and top plate, and outer or annular tubes between intermediate plate and top plate.

GERMAN.—ABRIDGMENTS.

154797. The Firm of F. HALLSTRÖM, of Neinburg, O.S. *An evaporator for viscous substances, more particularly sugar masse-cuite, provided with a circulation pipe centrally arranged over the heating body.* 2nd April, 1903. This boiling-down pan or evaporator has a central circulation pipe arranged over the heating body, which pipe is provided with slots and baffle or rebounding plates, so that at any height of the masse-cuite its circulation can take place through these slots.

155940. MAX GERLOFF, of Brunswick. *Apparatus for sawing up sugar blocks, sugar loaves and the like, having two opposed circular saws or groups of such saws.* 15th December, 1903. The apparatus for sawing up sugar blocks, sugar loaves or the like, has two opposed circular saws or groups of such saws. The connecting line of the centres of two facing saw blades is directed obliquely to the

course of the block or loaf in such a way that first only one and then the other group of saws cuts beyond the centre of the sugar block, loaf, or the like.

155562. Ferdinand Kaehl, of Berlin. *A centrifugal mounted on a horizontal shaft, more particularly for starch making.* 1st August, 1903. This invention relates to a centrifugal mounted on a horizontal shaft, and more particularly intended for use in the manufacture of starch, and is characterised by two hollow conical halves held together by two perforated hubs of different diameter, one of which serves for introducing the material to be centrifugalled, and the other, which is surrounded by a hollow ring, for carrying off the separated water, the two halves of the centrifugal being mounted in the ordinary manner on a solid driving shaft.

156148. Otto Bredt & Co., of Unterbarmen. *A process for making soluble starch by means of permanganate.* 6th October, 1903. This invention relates to a process for making soluble starch by means of permanganate, and consists in employing the well-known action of permanganate on starchy substances of all kinds, by treating such substances, preferably at a temperature closely below the limit at which the kind of starch actually employed becomes pasty (about 50° C.), with more permanganate in suitable solution than is necessary for oxidation of the extractive substances and the like, until the starch is converted into a soluble form.

WEEKLY STATEMENT OF COMPARATIVE

For the last Fifty-two weeks compared

	German Beetroot 88 o/o Prompt, free on board.						French Crystals. No. 3. c. f. i.			West India. Good Brown.			Java afloat. No. 15 and 16.		
	1904.		1903.		1902.		1904.	1903.	1902.	1904.	1903.	1902.	1904.	1903.	1902.
Jan. 8..	8/4¾	8/3½	8/0¾	8/-	6/5¾	6/5	10/1½	—	8/2¼	—	—	—	9/3	9/4½	8/6
15..	8/3½	8/1	8/-	8/1	6/5	6/7½	10/-	—	8/5¼	—	—	—	9/1½	9/4½	8/3
22..	8/1	7/10¼	8/1	8/-	6/7½	6/7½	10/-	—	8/5¼	—	—	—	8/9	9/4½	8/3
29..	7/10¼	7/10¼	8/0	7/10½	6/7½	6/8¾	9/10½	—	8/7½	—	—	—	8/7½	9/4½	8/3
Feb. 5..	7/10¼	7/9½	7/10½	7/10½	6/8¾	6/9	9/6	—	8/7½	—	—	—	8/4½	9/4½	8/4½
12..	7/9½	7/9	7/10½	7/11¼	6/9	6/8½	9/6	—	8/7½	—	—	—	8/6	9/4½	8/7½
19..	7/9	7/11	7/11¾	8/2	6/8½	6/10	9/7½	—	8/9¾	—	—	—	8/7½	9/4½	8/7½
26..	7/11	8/0	8/2	8/4	6/10	6/8	9/9	—	8/7½	—	—	—	8/7½	9/6	8/7½
March 4..	8/0	8/2½	8/4	8/4½	6/8	6/5½	9/9¾	—	8/3	—	—	—	8/7½	9/6	8/7
11..	8/2½	8/3	8/4½	8/5¼	6/5½	6/3½	9/10½	—	8/2¼	—	—	—	8/10½	9/9	8/4
18..	8/3	8/3½	8/5¼	8/3¾	6/3½	6/3¼	10/-	—	8/3¾	—	—	—	8/10½	9/10½	8/-
25..	8/3¼	8/5½	8/3¾	8/2¼	6/3¼	6/6¾	10/2¼	—	8/7½	—	—	—	9/1½	9/10½	8/3
April 1..	8/5½	8/6½	8/2¼	8/2¼	6/6¾	6/5½	10/4½	—	8/6	—	—	—	9/3½	9/7½	8/3
8..	8/6½	8/6	8/2¼	8/3	6/5½	6/5½	10/4½	—	8/5¼	—	—	—	9/4¼	9/7½	8/-
15..	8/6	8/5½	8/3	8/5	6/5½	7/2¾	10/3¾	—	8/3	—	—	—	9/5¼	9/7½	8/-
22..	8/5½	8/7½	8/5	8/4½	6/2¾	6/1	10/6¾	—	8/1½	—	—	—	9/5¼	9/10½	7/9
29..	8/7½	8/9½	8/4¼	8/4	6/1	6/3	10/9	—	8/4½	—	—	—	9/8	9/10½	7/9
May 6..	8/9½	8/11½	8/4	8/3½	6/3	6/4¼	10/11¼	10/-	8/7½	—	—	—	9/9¾	9/10½	7/9
13..	8/11½	9/2	8/3½	8/4¼	6/4¼	6/4	11/2¼	10/-	8/6	—	—	—	10/3	9/10½	7/9
20..	9/2	9/6½	8/4¼	8/3¼	6/4	6/2	11/3	10/-	8/5¼	—	—	—	10/4½	9/10½	7/9
27..	9/6½	9/4¼	8/3¼	8/2¾	6/2	6/2¾	11/6¼	10/-	8/5¼	—	—	—	10/4½	9/10½	7/9
June 3..	9/4¼	9/2	8/2¾	8/1½	6/2¾	6/2½	11/4½	9/9	8/5¼	—	—	—	10/6	9/10½	7/9
10..	9/2	9/0½	8/1½	8/0¼	6/2½	6/3½	11/2¼	9/9	8/6	—	—	—	10/5¼	9/7½	7/9
17..	9/0½	9/1¼	8/0¼	7/11¼	6/3½	6/2	11/3¼	9/9	8/3¾	—	—	—	10/3	9/7½	7/6
24..	9/1¼	9/3	7/11¼	7/8½	6/2	6/-	11/3	9/9	8/2¼	—	—	—	10/3	9/6	7/6
July 1..	9/3	9/4¼	7/8½	7/9¼	6/2	*5/11½	11/3	9/9	8/0¾	—	—	—	10/3	9/4½	7/6
8..	9/4¼	9/7¼	7/9¼	7/10¾	5/11½	5/11¾	11/3¾	9/9	8/1½	—	—	—	10/6	9/4½	7/9
15..	9/7¼	9/8	7/10¾	7/11½	5/11¾	5/11½	11/3¾	9/9	8/3	—	—	—	10/6	9/4½	7/9
22..	9/8	9/8½	7/11½	7/11½	5/11½	6/0½	11/4½	9 9	8/6	—	—	—	10/6	9/6	7/9
29..	9/8½	9/9½	7/11½	8/0½	6/10½	6/-	11/4½	9/9	8/6	—	—	—	10/9	9/6	7/9
Aug. 5..	9/9½	10/1¼	8/0½	8/2¾	6/-	6/-	11/8¼	Nom.	8/6	—	—	—	11/-	9/7	7/9
12..	10/1¼	10/5¾	8/2¾	8/3¾	6/-	6/1	11/9¾	10/-	8/5¼	—	—	—	11/3	9/9	7/9
19..	10/5¾	10/6	8/3¾	8/5½	6/1½	6/1¾	12/0	Nom.	8/0¾	—	—	—	11/3	9/10	7/9
26..	10/6	10/6½	8/5½	8/5¾	6/1¾	6/-	12/0	Nom.	8/0¾	—	—	—	11/4½	9/10	7/9
Sept. 2..	10/6½	10/8	8/5¾	8/5½	6/-	5/11	12/1½	10/3¾	8/-	—	—	—	11/7½	9/10½	7/9
9..	10/8	10/7½	8/5½	8/5¼	5/11	5/11½	12/2¼	10/5¼	8/1½	—	—	—	11/9	9/10½	7/9
16..	10/7½	10/6	8/5¼	8/5¼	5/11½	6/1	12/1½	10/5¼	8/3	—	—	—	11/9	9/10½	7/9
23..	10/6	11/0	8/5¼	8/4½	6/1	6/3¼	12/10½	10/3	8/4½	—	—	—	11/10½	9/10½	7/9
30..	11/0	11/2	8/4½	8/5¼	6/3¼	7/2	13/-	10/3	9/9	—	—	—	12/4½	9/10½	8/-
Oct. 7..	11/2	11/1¼	8/5¼	8/9½	7/2	7/1	Nom.	10/3	9/9	—	—	—	12/3	9/10½	8/-
14..	11/1¼	10/11¼	8/9½	8/9¾	7/1	7/2½	—	10/2¼	9/9	—	—	—	12/3	9/10½	8/6
21..	10/11¼	11/-	8/9¾	8/9¼	7/2½	7/7	—	12/2¼	10/3	—	—	—	12/3	9/10½	9/-
28..	11/-	11/1½	8/9¼	9/6	7/7	7/6	—	10/2¼	—	—	—	—	12/4½	9/9	9/3
Nov. 4..	11/1½	12/10¾	9/6	8/7	7/6	7/5½	—	10/1½	—	—	—	—	13/3	9/7½	9/3
11..	12/10¾	13/9	8/7	8/6	7/5½	7/6½	—	10/1½	—	—	—	—	14/3	9/7½	9/-
18..	13/9	14/1	8/6	8/5½	7/6½	7/10	—	10/1½	—	—	—	—	15/3	9/7½	9/-
25..	14/1	14/0½	8/5¼	8/4½	7/10	7/11	—	10/1½	—	—	—	—	15/3	9/4½	9/-
Dec. 2..	14/0½	14/1	8/4½	8/4	7/11	8/2¾	—	10/1½	—	—	—	—	15/4½	9/4½	9/3
9..	14/1	14/5	8/4¼	8/4	8/2¾	8/4¾	—	10/1½	—	—	—	—	15/4½	9/4½	9/3
16..	14/5	13/9¾	8/4	8/5	8/4¾	8/2	—	10/3	—	—	—	—	15/4½	9/4½	9/3
23..	13/9¾	14/2½	8/5	8/4½	8/2	8/1¾	—	10/3	—	—	—	—	15/4½	9/3	9/3
30..	14/2½	14/5	8/4½	8/4¾	8/1¾	8/0¾	—	10/3	—	—	—	—	15/4½	9/1½	9/4½

* 5/10½ on July 2nd.

PRICES OF RAW AND REFINED SUGAR,

with those of the two previous years.

	Tate's Cubes. No. 1.			Tate's Cubes. No. 2.			First Marks German Granulated f. o. b.			Say's Cubes f. o. b.			German & Austrian † Cubes f. o. b.		
	1904.	1903.	1902.	1904.	1903.	1902.	1904.	1903.	1902.	1904.	1903.	1902.	1904.	1903.	1902.
Jan. 8..	17/10½	18/-	17/6	17/4½	17/-	16/9	10/4½	9/3¾	8/5¼	12/3	11/9	11/-	11/10½	11/3	10/4½
15..	17/10½	18/-	18/3	17/4½	17/-	17/6	10/1½	9/5¼	8/6	12/3	11/9	11/-	11/9	11/3	10/1½
22..	17/9	18/-	18/-	17/3	17/-	17/6	9/11¼	9/3¾	8/6	12/3	11/9	11/-	11/7½	11/3	10/1½
29..	17/9	17/9	18/-	17/3	16/9	17/6	10/-	9/3	8/8¼	12/3	11/9	11/-	11/6	11/3	10/1½
Feb. 5..	17/7½	17/9	17/9	17/-	16/9	17/3	9/10½	9/3	8/8½	12/3	11/6	11/-	11/3	11/1½	10/1½
12..	17/7½	17/9	17/6	16/10½	16/9	17/-	9/9	9/4½	8/8¼	12/3	11/6	11/-	11/3	11/-	10/1½
19..	17/7½	17/10½	17/6	16/10½	16/10½	17/-	10/-	9/6	8/7½	12/3	11/6	11/-	11/4½	11/1½	10/1½
26..	17/9	18/3	17/6	16/10½	17/1½	16/9	10/0¾	9/7½	8/5½	12/-	11/6	11/3	11/4½	11/4½	10/1½
March 4..	17/9	18/3	17/6	16/10½	17/3	16/9	10/2¼	9/7½	8/-	12/-	11/6	11/3	11/6	11/6	10/-
11..	17/10½	18/3	17/6	16/10½	17/3	16/6	10/3	9/7½	7/10½	12/3	11/6	10/9	11/6	11/6	10/-
18..	18/-	18/3	17/6	17/-	17/3	16/6	10/3¾	9/7½	7/11¼	11/9	11/6	10/9	11/6	11/6	9/10½
25..	18/1½	18/3	17/6	17/1½	17/3	16/6	10/5¼	9/6	8/4½	12/-	11/6	11/-	11/9	11/6	10/-
April 1..	18/1½	18/3	17/6	17/1½	17/3	16/6	10/6	9/6	8/2¼	12/-	11/6	10/6	11/9	11/6	9/10½
8..	18/3	18/3	18/6	17/3	17/3	17/-	10/5¼	9/6¾	8/-	12/3	11/6	10/6	11/9	11/6	9/9
15..	18/3	18/3	17/6	17/3	17/3	16/6	10/4½	9/9¾	7/9¾	12/3	11/6	10/6	11/9	11/6	9/6
22..	18/4½	18/4½	17/-	17/4½	17/3	16/-	10/6¾	9/10½	7/7½	12/3	—	10/6	11/9	11/6	9/7½
29..	18/7½	18/4½	17/-	17/7½	17/3	16/-	10/9	9/11¼	7/9	12/6	—	10/3	12/1½	11/6	9/9
May 6..	13/7½	18/4½	17/-	17/7½	17/3	16/-	10/9¾	9/9¾	7/9¾	12/6	12/1½	10/3	12/1½	11/6	9/9
13..	18/10½	18/4½	17/-	17/10½	17/3	16/-	11/-	9/9¾	7/9¾	13/3	12/1½	10/3	12/4½	11/4½	9/7½
20..	19/1½	18/1½	17/-	18/1½	17/-	16/-	11/4½	9/9¾	7/9	13/6	12/1½	10/3	12/7½	11/4½	9/6
27..	19/3	18/-	17/-	18/3	17/-	16/-	11/3	9/9	7/8¼	13/9	12/-	10/3	12/9	11/4½	9/6
June 3..	19/3	18/-	17/-	18/3	17/-	16/-	11/0¾	9/7½	7/7½	13/9	12/-	10/3	12/9	11/4½	9/4½
10..	18/10½	18/-	17/-	17/10½	17/-	16/-	11/-	9/6	7/9	13/9	12/-	10/3	12/9	11/4½	9/6
17..	18/10½	18/-	17/-	17/10½	17/-	16/-	11/1½	9/4½	7/7½	13/6	11/10½	10/-	12/9	11/3	9/4½
24..	18/9	17/10½	17/-	17/9	16/10½	16/-	11/-	9/3	7/6	13/6	11/10½	10/-	12/7½	11/3	9/4½
July 1..	18/9	17/9	17/-	17/9	16/9	16/-	11/2¼	9/3	7/4½	13/-	11/10½	10/-	12/7½	11/1½	9/4½
8..	18/9	17/9	17/-	17/9	16/9	16/-	11/4½	9/5¼	7/4½	13/-	11/10½	10/-	12/10½	11/2¼	9/4½
15..	19/-	17/9	17/-	18/-	16/9	16/-	11/6	9/6¾	*7/4½	13/3	11/10½	10/-	13/-	11/4½	9/3
22..	19/3	17/10½	17/-	18/3	17/-	16/-	11/6¾	9/6¾	7/6	13/6	11/10½	10/-	13/1½	11/5¼	9/3
29..	19/6	18/1½	17/-	18/7½	17/3	16/-	11/9¾	9/10½	7/4½	13/6	12/-	10/-	13/4½	11/6	9/3
Aug. 5..	19/7½	18/4½	17/-	18/10½	17/9	16/-	12/1½	10/0¾	7/5¼	13/9	12/9	10/-	13/7½	11/10½	9/4½
12..	20/-	18/4½	17/-	19/3	17/9	16/-	12/2¼	10/1½	7/6¾	14/3	12/9	10/-	14/-	11/10½	9/4
19..	20/-	18/6	17/-	19/3	18/-	16/-	12/3	10/3¾	7/6¾	14/3	13/3	10/-	14/1½	12/3	9/4½
26..	20/-	18/9	17/-	19/3	18/-	16/-	12/4½	10/4½	7/6¾	14/3	13/3	10/-	14/1½	12/3	9/3
Sept. 2..	20/1½	18/9	16/9	19/4½	19/-	15/9	12/6¾	10/3¾	7/6	14/3	13/3	10/-	14/4½	‡	9/3
9..	20/4½	18/9	16/6	19/7½	18/-	15/6	12/6¾	10/3	7/6	14/3	13/3	10/-	14/4½	‡	9/3
16..	20/4½	18/9	16/6	19/7½	18/1½	15/6	12/6	10/3¾	7/7½	14/3	13/3	10/-	14/4½	‡	9/3
23..	20/7½	18/9	16/6	20/-	18/1½	15/6	13/3	10/2¼	7/9¾	14/9	20/10½	10/3	14/10½	‡	Nom.
30..	20/10½	18/9	17/-	20/3	18/1½	16/-	13/3¾	10/1½	8/3¾	15/-	20/10½	10/9	15/-	‡	—
Oct. 7..	20/10½	18/9	17/-	20/3	18/-	16/-	12/10½	10/1½	8/2¼	15/-	20/10½	10/9	15/-	12/3	—
14..	20/10½	18/9	17/-	20/3	18/-	16/-	12/9	10/1½	8/3¾	15/-	20/10½	10/7½	15/1½	12/4½	10/3
21..	21/-	18/6	17/3	20/4½	17/10½	16/6	12/10½	10/2¼	8/8¼	15/-	20/10½	11/-	15/1½	12/4½	10/6
28..	21/-	18/3	17/3	20/4½	17/9	16/6	13/-	10/2¼	8/6¾	15/-	20/10½	11/-	15/1½	12/3	10/6
Nov. 4..	22/1½	18/3	17/3	21/7½	17/9	16/6	14/4½	10/0¾	8/7½	16/3	20/10½	11/-	16/6	12/1½	10/6
11..	23/6	18/3	17/3	22/9	17/9	16/6	15/0¾	10/1½	8/8¼	17/3	20/10½	11/-	16/10½	12/1½	10/6
18..	23/10½	18/3	17/9	23/1½	17/9	16/9	15/6	10/1½	9/0¾	18/-	20/10½	11/6	17/10½	11/10½	10/10½
25..	23/10½	18/3	18/-	23/1½	17/9	17/-	15/6	10/1½	9/2¼	18/-	20/10½	11/9	17/10½	11/9	11/-
Dec. 2..	23/10½	18/3	18/1½	23/1½	17/9	17/1½	15/6	10/1½	9/7½	18/-	20/10½	11/9	18/-	11/10½	11/4½
9..	24/1½	18/3	18/3	23/4½	17/9	17/3	15/11¼	10/1½	9/9¾	20/-	‡	12/-	18/-	11/9	11/6
16..	24/1½	18/3	18/3	23/4½	17/9	17/3	15/6	10/3	9/6	20/-	—	12/-	18/-	11/9	11/6
23..	24/1½	18/3	18/3	23/4½	17/9	17/3	15/9¾	10/4½	9/6	19/-	—	12/-	18/-	11/10½	11/6
30..	24/1½	17/10½	18/3	23/4½	17/4½	17/3	16/-	10/6	9/4½	19/-	—	12/-	18/-	11/10½	11/3

* 7/3¾ on July 18. † Basis average Hansa FKL FMS. ‡ Not quoted.

H. H. HANCOCK & Co., 39, Mincing Lane, London, E.C.

IMPORTS AND EXPORTS OF SUGAR (UNITED KINGDOM)

To end of December, 1903 and 1904.

IMPORTS.

Raw Sugars.	Quantities.		Values.	
	1903. Cwts.	1904. Cwts.	1903. £	1904. £
Germany	5,783,869	6,293,113	2,454,020	3,111,413
Holland	208,264	749,614	80,646	415,273
Belgium	684,737	1,012,521	283,220	559,448
France	544,492	486,573	237,937	254,714
Austria-Hungary	1,688,495	738,183	709,708	344,676
Java	544,421	1,877,510	262,171	917,478
Philippine Islands	70,646	86,968	25,285	31,165
Cuba	448,682	....	215,647	....
Peru	384,937	1,019,267	156,824	508,518
Brazil	78,761	84,301	31,274	32,295
Argentine Republic	418,386	....	184,711	....
Mauritius	305,164	524,280	109,396	198,838
British East Indies	286,160	211,417	106,409	86,841
Br. W. Indies, Guiana, &c.	675,454	1,043,902	404,219	711,608
Other Countries	526,211	548,699	233,322	286,044
Total Raw Sugars	12,648,679	14,676,348	5,494,789	7,458,311
Refined Sugars.				
Germany	14,391,722	11,085,230	7,596,975	6,805,446
Holland	2,027,357	3,168,186	1,301,587	2,001,603
Belgium	142,097	541,731	83,379	332,039
France	911,309	2,636,433	519,003	1,554,879
Other Countries	936,235	186,514	465,707	100,922
Total Refined Sugars	18,588,720	17,618,094	9,966,651	10,794,889
Molasses	1,630,529	1,945,045	301,847	362,958
Total Imports	32,867,928	34,239,487	15,763,287	18,616,158

EXPORTS.

British Refined Sugars.	Cwts.	Cwts.	£	£
Sweden and Norway	33,032	34,406	16,826	19,496
Denmark	99,389	112,058	54,145	60,268
Holland	70,222	70,519	37,421	41,671
Belgium	11,460	11,297	5,885	6,390
Portugal, Azores, &c.	10,257	18,480	5,857	10,481
Italy	8,462	4,311	3,946	2,174
Other Countries	796,372	337,997	490,658	227,418
	1,029,194	589,068	614,738	367,898
Foreign & Colonial Sugars.				
Refined and Candy	43,365	23,805	27,268	16,945
Unrefined	59,111	100,879	31,437	57,052
Molasses	2,638	2,625	1,207	1,311
Total Exports	1,134,308	716,377	674,650	443,206

UNITED STATES.

(Willett & Gray, &c.)

(Tons of 2,240 lbs.)	1905. Tons.		1904. Tons.
Total Receipts, Jan. 1st to Jan. 19th ..	64,565	..	81,908
Receipts of Refined ,, ,, ,, ..	100	..	....
Deliveries ,, ,, ,, ..	64,565	..	82,784
Consumption (4 Ports, Exports deducted) since 1st January	64,900	..	65,700
Importers' Stocks (4 Ports) Jan. 18th ..	....	..	11,285
Total Stocks, Jan. 25th.	84,000	..	78,327
Stocks in Cuba, Jan. 25th	75,000	..	101,541
	1904.		1903.
Total Consumption for twelve months ..	2,727,162	..	2,549,643

CUBA.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1903 AND 1904.

(Tons of 2,240lbs.)	1903. Tons.		1904. Tons.
Exports	879,200	..	1,090,061
Stocks	122,638	..	682
	1,001,838	..	1,090,743
Local Consumption (twelve months)	39,570	..	44,320
	1,041,408	..	1,135,063
Stock on 1st January (old crop)	42,530	..	94,835
Receipts at Ports up to November 30th ..	998,878	..	1,040,228

Havana, 30th November, 1904. J. GUMA.—F. MEJER.

UNITED KINGDOM.

STATEMENT OF IMPORTS, EXPORTS, AND CONSUMPTION FOR TWELVE MONTHS ENDING DECEMBER 31ST.

SUGAR.	Imports. 1902. Tons.	1903. Tons.	1904. Tons.	Exports (Foreign). 1902. Tons.	1903. Tons.	1904. Tons.
Refined	918,271	929,436	880,905	2,212	2,168	1,190
Raw	661,074	632,434	733,817	4,567	2,955	5,044
Molasses	69,080	81,526	97,252	98	132	131
Total	1,648,425	1,643,396	1,711,974	6,877	5,255	6,365

	Home Consumption. 1902. Tons.	1903. Tons.	1904. Tons.
Refined	908,229	878,251	874,839
Refined (in Bond) in the United Kingdom	—	87,152	529,804
Raw	627,588	418,519	119,356
Molasses	67,165	79,186	90,447
Molasses, manufactured (in Bond) in U.K.	—	13,747	60,778
Total	1,602,982	1,476,855	1,675,184
Less Exports of British Refined	35,800	51,459	29,453
Total Home Consumption of Sugar	1,567,182	1,425,396	1,645,731

Stocks of Sugar in Europe at uneven dates, Jan. 1st to 25th, compared with previous Years.

In thousands of tons, to the nearest thousand.

Great Britain.	Germany including Hamburg.	France.	Austria.	Holland and Belgium.	Total 1905.
130	1086	673	577	181	2647

	1904.	1903.	1902.	1901.
Totals	3563 ..	3329 ..	3489 ..	2822

Twelve Months' Consumption of Sugar in Europe for Three Years, ending November 30th, in thousands of tons.

(Licht's Circular.)

Great Britain.	Germany.	France.	Austria.	Holland, Belgium, &c.	Total 1903-4.	Total 1902-3.	Total. 1901-2.
1777	1085	681	477	191	4210	3723	3655

Estimated Crop of Beetroot Sugar on the Continent of Europe for the current Campaign, compared with the actual crop of the three previous Campaigns.

(From Licht's Monthly Circular.)

	1904-1905. Tons.	1903-1904. Tons.	1902-1903. Tons.	1901-1902. Tons.
Germany	1,590,000 ..	1,927,681 ..	1,762,461 ..	2,304,923
Austria	905,000 ..	1,167,959 ..	1,057,692 ..	1,301,549
France	620,000 ..	804,308 ..	833,210 ..	1,123,533
Russia	940,000 ..	940,000 ..	1,256,311 ..	1,098,983
Belgium	170,000 ..	203,446 ..	224,090 ..	334,960
Holland	135,000 ..	123,551 ..	102,411 ..	203,172
Other Countries.	335,000 ..	431,116 ..	325,082 ..	393,236
	4,685,000	5,864,938	5,561,257	6,760,356

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☞ The Editor is not responsible for statements or opinions contained in articles which are signed, or the source of which is named.

NOTES AND COMMENTS.

The Sugar Users' Journal.

A new monthly publication, called *The Sugar Users' Journal*, has recently been started. Its object is apparently, as its name implies, to further the interests of those trades which use sugar as a raw material. We fear, therefore, that it will bode no good for the sugar industry in general. If its aggressive policy is confined to securing the repeal of the sugar tax, we shall have nothing to say. The tax is purely a revenue one and it is for the revenue authorities to decide whether to retain it or not. But if the *Sugar Users' Journal* goes further and aims at the destruction of the Brussels Convention and a return to the old days of artificially cheap prices in sugar, then it will behove all those interested in the welfare of the sugar industry and sugar consumers as a whole to oppose such a policy.

The sugar users, by which we take it are meant the confectioners and mineral water manufacturers, have certainly fallen on less profitable times; but they are suffering from the effects of *free trade*, the fetish of the very party they most consistently support. Whereas hitherto the confectioners have enjoyed a monopoly of the European confectionery business, they are now face to face with a new and growing competition on the part of their Continental confrères, who, freed at last from the trammels of excessive sugar taxation, have not been slow to make an attempt to capture a portion at least of the

confectionery trade of their own country. But this is only *free trade!* What else would these British sugar users have? *Protection* apparently; only they think that by any other name it would smell sweeter, hence they would rather have the old *status quo* back again, than suggest a protective duty be placed on foreign confections coming into this country. The former plan can by some dexterous juggling be labelled *free trade;* the latter bears the 'mark of the beast,' it would be pure undiluted protection; so say these disciples of Cobden and Cox. It would be better in the long run for these sugar users if they would definitely accept Mr. Chamberlain's policy: no tax on sugar but a tax on imported manufactures, amongst which we suppose would be included confectionery and jams. They have, however, committed themselves to the policy of the Radical Party, and their last state will, we fear, be worse than the first. Cheap confectionery will soon be dumped here from abroad, and the foreign markets, at present open to the British product, will be ultimately closed by suitable tariffs. But why grumble? This will be merely *free trade*, such as this country enjoys at the present day in most of its manufacturing industries!

As to the mineral water manufacturers, we would just point out that the Winter is a very convenient time for grumbling over bad trade and the discharging of workmen. For it is obvious that during the colder half of the year the demand for mineral waters, especially the kinds which require sugar in plenty, drops to an enormous extent. Since a wet or a dry summer makes a ruinous difference to the trade it is not difficult to imagine what the difference between the summer and the winter output is. But the sugar tax and the sugar Convention have to be fought tooth and nail, so it comes to pass that an annual loss, which in ordinary years is borne as a matter of course, is this time exaggerated to excessive proportions for political exigencies.

The Revival in Cane Sugar.

It is pleasant to turn from an industry which has been clearly bolstered up by protection (disguised no doubt) to another which has always asked for no more than a fair field and no favours. We refer to the manufacture of cane sugar machinery. We hear on all hands that the firms engaged in this trade are full up with orders from all parts of the world. The stagnation caused by the bounties is gone, and in every cane growing country a new impetus has been given to re-starting the industry on a larger and more up-to-date scale. It is significant that the effect of the Brussels Convention on the cane sugar industry has been shown no more prominently in the West Indies than in the other cane-producing areas; in fact, we think the latter, if we are to judge by their energetic movements, recognise more readily the value of the new order of things. At any rate, we

are assured of one thing: unless a series of adverse weather conditions ruins successive crops, by the time the Brussels Convention comes up for renewal the available cane sugar supplies of the world will be so vast that no British Government will care to encourage a return to the old bounty system where beet sugar ruled the world's markets. Neither do we think any of the continental States will desire to do so; they will see that cheap consumption for the nation as a whole is a sounder policy than a subsidized industry run for the benefit of a few hundred "sugar barons."

Further Findings of the Brussels Commission.

The Official Report on the Brussels Commission which met last October was recently published. It shows that the work of the Commission was confined to an examination of the question of sugared products, and to the fixation of countervailing duties on sugar imported from certain countries.

With regard to *sugared products*, the British Commissioners desired that "the maximum limit of surtax on sugared products containing more than 50 % in weight of sugar should be 6 fr. per 100 kg." However, the Commission did not see their way to adopt this proposal, as far as the "50 %" was concerned.

The Commission next proceeded to arrange for countervailing duties on sugar coming from Bolivia, Brazil, Greece, Guatemala, Hayti, Honduras, Nicaragua, Paraguay, Philippine Islands, Portugal, and certain Portuguese Possessions.

The British Government, on hearing of this, saw fit to lodge a protest against all the duties fixed save those for Brazil. It suggested an immediate reassembly of the Commission to further discuss the matter, or failing that, a postponement till April next of a fresh discussion. After some diplomatic correspondence, the Governments parties to the Commission agreed to the matter being deferred till April next when the Commission will re-assemble.

Modern Sugar Machinery.

Owing to unforeseen delay in the delivery of some electro blocks we are unable to include in this number the continuation of our review of modern sugar machinery. We hope, however, in our next number to continue the series, and to illustrate in line and perspective some of the types described.

Errata.—In our February issue on page 55, line 9 from bottom, "Beyer" should have been "Meyer."

SIR EDWARD CLARKE, K.C., ON SUGAR BOUNTIES AND THE CONVENTION.*

This appears to us the most masterly exposition of the subject that has yet appeared, and one well worth the careful attention of all who prefer truth to fiction, and who desire that the people of this country should know the truth and be able to contradict, in view of the approach of a General Election, as Sir Edward Clarke puts it, "the ignorant and unscrupulous attacks which have been made upon the Government."

In glancing at the attempts to deal with and procure the abolition of these bounties during the last forty years, Sir Edward Clarke begins by quoting "the precise words of prominent men on either side of political opinion," in proof of his statement that "all political economists and leaders of both our political parties have agreed that bounties are extremely mischievous to trade, and that wherever they have been unwisely introduced they ought at the earliest possible moment to be got rid of." He quotes the well-known words from Cobden, who cared not whether a commodity became dearer or cheaper with free trade, provided that the people had it at its natural price; and from Mr. Gladstone, who repudiated any cheapness produced by the concealed subsidies of a foreign State, with the effect of crippling and destroying capitalists and workmen engaged in a lawful branch of British Trade; and who, on another occasion, condemned any artificial advantage given in our markets to the products of foreign labour, the principle to be observed being equality. He did not think that any benefit founded on inequality and injustice could bring good even to the consumer. The late Lord Farrer is quoted as urging that we must not, because bounties might make sugar a little cheaper in this country, say that they ought to be continued. But Sir Edward Clarke forgot that Lord Farrer sometimes contradicted himself, and that on another occasion, in 1898, he said: "The best line to take is to say plainly and strongly that these bounties give England cheap sugar, and that we should do nothing by legislation to prevent cheap sugar from coming to this country." He evidently was unaware that bounties, by discouraging the natural production of sugar, had driven prices up in 1885 to 17s., in 1887 to 15s. 6d., in 1889 to 28s. 3d., and in 1893 to 19s.; and that the average price of the 15 years ending 1898, when he uttered those words, was 12s. 6d., a price considerably above the present cost of production.

Sir Edward Clarke then passed on to the report of the Select Committee of the House of Commons, in 1879, and to the commencement, in 1881, of the impatience of the working men of this country

*An Address delivered at the Constitutional Club, February 1st, 1905. Stevens and Haynes, Law Publishers, Bell Yard, Temple Bar. Price Sixpence.

at the failure of the Government to take effective action; and the persistent refusal of the Liberal Government "to take, or even to consider, any practical step to remedy the evils of which our people at home and in the colonies were complaining." Sir Thomas Farrer was master of the situation and persisted in disregarding the views of Cobden and Gladstone as quoted above. "A deputation of sugar refiners, who went to Mr. Mundella, the President of the Board of Trade, on March 30th, 1886, and found him flanked by Sir Thomas Farrer and Mr. Robert Giffen, received no comfort."

Then came the change of Government, and an International Conference was invited to meet in London. The hands of the Government were greatly strengthened at this time by the action of the Trade Unions who demanded the abolition of the sugar bounties. A deputation, representing the Trade Unions of London, Liverpool, Glasgow, Manchester, Leeds, Birmingham, Cardiff, Bristol, Swansea, Newcastle, Bolton, Accrington, Salford, Sheffield, Durham, Burslem, Leicester, Barrow-in-Furness, Hyde, Derbyshire, Ipswich, Nottingham, Warrington, South Shields, Carnarvon and Dundee, was introduced to Lord Salisbury on July 22nd, 1887, by Mr. Thomas Burt, the Radical Member for Morpeth, who was accompanied by the most conspicuous representatives of the Radical Labour Party. They represented to the Foreign Secretary that the unnatural and artificial state of things created by the bounties was injuring not only the sugar industries but many others dependent upon them. At the very outset of his reply Lord Salisbury said: "I need not say that this is a subject which I have always felt to be of the deepest moment, raising issues of great importance and perhaps introducing us to other very wide controversies which are likely to be raised in this country." He felt that nothing that had been said that day with respect to the injustice of these bounties upon the British working man had been said too strongly. He thought it quite natural that great indignation should exist at seeing our eagerness in the principles of Free Trade as it were turned against ourselves; and that, by what has been fairly described as an illegitimate conspiracy, we are driven out of the industry of our own markets. These were significant words then, and they are still more significant now, when economic fallacies are rampant and British industries are threatened on all sides by Cartel Bounties. Lord Salisbury clenched the argument thus: "Now what I want you to consider is this, that you are dealing with an adversary who is doing you wrong. If a man hits you, you have two ways of dealing with him. You may expostulate with him, and point out to him the extreme impudence and wickedness to himself of hitting you as he is doing; or, if you think that that mode of action is not likely to lead to a satisfactory and a sufficient result, you may act to him as he is acting to you. That is the whole philosophy of this question. I want you, as someone has said, to clear your minds

of cant, and distinctly to understand what the issue is. I have no doubt that when the public opinion of England, and especially of the working class of England, has made up its mind on this matter, we shall act with dignity and we shall act with effect."

This good advice is even more valuable now than it was then. It is marvellous that it should have been successfully opposed then in the name of "Free Trade"; will the same fallacy be equally successful now?

On the 30th November, 1887, the London Trades' Council put forward specific proposals, namely, that under the Convention to be formed England should undertake that the contracting countries should not be placed thereby at any disadvantage in British markets as compared with countries refusing to join the Convention. On the 22nd March, 1888, a meeting of Trade Union delegates, representing 500,000 working-men, passed resolutions calling on the Ministry to free British markets from the injurious operation of the bounty system. On July 27th, resolutions in favour of prohibiting the importation of bounty-fed sugar were passed by more than fifty Trade Unions, and by the Amalgamated Association of Operative Cotton Spinners and the Birmingham Trades' Council. This was only repeating what the House of Commons Committee of 1879-80 had established, namely, that countervailing duties would only have the effect of restoring the natural course of trade, while the bounties, so long as they continued, would be received by our Government and applied in relief of taxation.

Thus Radical working-men turned to a Conservative Government for the defence of the injured and threatened industries of the country "by the just and simple means which the Liberal leaders,—the hide-bound pedants of a spurious Cobdenism,—had sighed over for years but would make no serious attempt to apply."

Sir Edward Clarke then goes on to describe the further increase of the bounties from 1892 to 1897, and the still greater increase from 1897 to recent times. As to the alleged benefit to the confectioners from artificial cheapness, he quotes the letters from Messrs. Batger & Co. and Messrs. James Keiller & Son in 1889, in which they declare that if bounties were abolished they "would be provided with a larger, a better, a cheaper, and a more reliable supply of sugar," and that they "would not be again liable to any such sudden and immense rise as that which was then paralysing the confectionery and allied trades." That was an exact counterpart of what has now happened, a rise caused by our dependence on the beetroot crop for our supply of sugar, and resulting in our suffering whenever that crop from climatic causes was deficient.

After a reference to the countervailing duties levied in the United States and India Sir Edward Clarke lays stress on the strong support

to the Government derived from the resolution of the Congress of the Chambers of Commerce of the Empire in 1900.

This, he says very truly, "put an end to hesitation. Parliament, Commerce, and Labour had all spoken, and with this national support ministers accepted at the Conference of 1901-2 the provision for a penal duty or prohibition."

The Address concludes with a brief review of the terms of the Convention, and a complete and detailed refutation of the absolutely unfounded cry that the recent rise in sugar has been caused by the abolition of bounties. "The shortness of supply of more than a million tons in the beet production [owing to the drought] sent the price up to nearly £10 a ton higher than it was at the signing of the Convention. It is only ignorance or dishonesty which attributes a rise of £10 to the removal of bounties which never exceeded £4 10s. and were on the average much less than that."

"Liberal politicians know all this, but they cannot resist the temptation of a new cry."

This Address should be in the hands of everyone who desires to defend a sound free trade measure and to refute the "ignorance or dishonesty of those who raise party cries on the basis of purely fictitious assertions."

For those who insist that foreign producers should no longer be protected in British markets it will form a useful handbook for future use.

THE PRICE OF SUGAR.

We gave last month the monthly average prices of sugar for the first year of the Convention.

Among the wild misstatements that find their origin among ignorant pamphleteers and are immediately repeated by leading Statesmen as well ascertained facts, there is one which has been greedily swallowed. The Convention, they say, has made *sugar* dearer here and cheaper in Germany. We are now enabled, by the publication of the figures by the statistical bureau of the German Empire, to give the exact figures of the monthly prices of sugar in Germany from 1st September, 1903, to 31st August, 1904.

The figures are given in marks per 50 kilogrammes. A mark is a shilling, and 50 kilogrammes are rather more than 110 lbs. The quotations are in the Magdeburg market. The figures we gave last month are shillings per 112 lbs., and the quotations include carriage to Hamburg and f.o.b. expenses.

With these reservations the comparison may be regarded as coming out accurately, and showing that *sugar* is no cheaper in Germany than it is here; and that, therefore, the Convention has made no

difference as between the two countries. The German duty is of course much higher than ours, but we are merely dealing with the price of sugar.

The German quotations give a range of price for each month, whereas our table gives the single average for the month, made up from the daily quotations.

"Average monthly prices of first products, basis 88% yield (without duty), at Magdeburg, in marks per 50 kilogrammes:"

September, 1903 ..	8·80 to 9·15	March, 1904 .	8·00 to 8·47
October ,, ..	8·20 to 8·15	April ,, ..	8·70 to 8·75
November ,, ..	8·05 to 8·25	May ,, ..	8·65 to 9·45
December ,, ..	8·10 to 8·50	June ,, ..	9·00 to 9·10
January, 1904 ..	7·75 to 8·30	July ,, ..	9·00 to 9·65
February ,, ..	7·70 to 8·05	August ,, ..	10·50 to 10·60

THE SPECIALIST *versus* THE-JACK-OF-ALL-TRADES.

Economic production being the result of division and specialisation of labour, the existing demand for the all-round man in certain quarters of the cane industry suggests the following remarks.

No one denies that sugar production is an industry covering a wide range of technical knowledge which may be said to fall within the scope of the agriculturist, the engineer, the sugar boiler and the chemist. The question then arises—Does this technical knowledge call for the co-operation of specialists in the several branches of the industry, or can one individual master all the knowledge required? A satisfactory answer involves two other questions—Has technical knowledge and experience any limits? and—Is the jack-of-all-trades the truly practical man? We will attempt to settle these questions first.

The engineer and sugar boiler may be selected as representing two essential units of skilled labour. If we trace the career of the former, we find that many years were devoted to learning the elements of his profession in the workshop and drawing office. With a general knowledge of machinery at his finger-tips, he eventually found his way to the land of the sugar cane, where he has since applied his more general knowledge to sugar machinery in particular. By thus specialising, he has not become a less practical engineer; on the contrary, the value of his services to the sugar industry increases with every additional year's experience. He has taken an interest in all branches of the industry and picked up useful information from his fellow-workers, but his own department offers abundant scope for his powers. If he has a complaint, it is that routine duties leave him little or no opportunity for learning by experiment much that might

be of material value to his employers. Defects in machinery, which were invisible to the designers, become obvious to him under the wear and tear of practical work, and had he but sufficient leisure to work out his own ideas, the value of his services might be indefinitely increased.

The pan boiler, also, has served a long apprenticeship, and has probably wielded the proof-stick from his youth. Yet, no matter how long his experience, he can never be certain of obtaining the result he desires, and frequently falls far short of it. But his difficulties are numerous; the syrup he boils is constantly varying in composition, and he may be called upon to produce crystals of a particular size and colour to suit different markets. Moreover, each vacuum pan possesses some individuality, and requires to be known and coaxed in a more or less special manner. Skill in handling the proof-stick and valves form but the A.B.C. of his craft; the crucial difficulty arrives when the almost microscopic crystals make their first appearance, and it has to be quickly decided whether sufficient grain has been formed to yield a properly crystallised masse-cuite after the grain has fully developed. It is here that trained powers of observation and judgment come into play, which can only be acquired by long practical experience. Without being a jack-of-all-trades, the competent man should possess sufficient chemical knowledge to fully understand the nature of the materials he treats and the scientific principles upon which methods of clarifying the juice are based. An elementary knowledge of physics and some skill as a mechanic should also form part of his training. But how many can lay claim to anything more than a rule-of-thumb knowledge of sugar making?

The efficiency of the engineer and pan boiler may, alike, be fairly measured in terms of training and experience, these two factors determining the market value of their services. We thus see the fallacy of supposing that the "practical" engineer is one who can not only erect a factory, but also teach the natives how to make sugar. Assuming that, under exceptional circumstances, the cart can be put before the horse, it remains to be shown that the same individual is equally competent for the two purposes mentioned. Obviously, his experience in the technical details of sugar manufacture will represent so many years to be deducted from his experience as an engineer, or *vice versa*; and his actual experience either as an engineer or as a sugar maker will be approximately one-half of that of the men who have made these subjects their life-long study.

The jack-of-all-trades is proverbially master of none, but even the specialist can only claim a very partial knowledge or experience of his profession. But, whilst the latter can be most effectively employed with the ideas and tools with which he is most familiar, it by no

means follows that he is a better engineer, sugar boiler, chemist, &c., for knowing nothing about the crafts which may be associated with his own. But between a general knowledge such as can be acquired by rubbing shoulders with other workers and the practical knowledge of the expert, there is a wide gulf fixed represented by the work of a lifetime. Even the modern chemical engineer, or engineering-chemist, forms no exception to the rule that a man cannot attempt to master more than a very limited range of knowledge. The chemical engineer has merely confined his study to those industrial manufacturing operations, where the construction of machinery and appliances has to be adapted for treating certain chemical products. His training is therefore even more specialised than that of either the chemist or engineer considered as such.

Considerable misunderstanding still exists as to the rôle of the chemist in the cane-sugar industry. The sugar producer is rarely a scientific man, and is therefore generally at a loss how to utilise the chemist, nor will he allow the latter to select his own sphere of utility. Thus he frequently cheats himself by paying the salary of a chemist for work which could be done equally well by a non-scientific man earning lower wages. The belief that a chemist must necessarily be able to boil a pan, or do anything else, on strictly scientific principles is a delusion. It is only by the united labours of the chemist in his laboratory and of the operator in the factory that the work of the latter can claim to be conducted on scientific lines.

We are yet far from having reached the limits of technical knowledge and efficiency in any one branch of sugar production, or of any other industry. The text book of to-day becomes out of date in a few years, and it is as much as the specialist can do to keep abreast of recent progress in his own department. But he should not rest content with up-to-date methods whilst his own brain may be capable of evolving something better, and it is to the originality of the specialist that the industry must look for future progress.

Turning to our second question regarding the economic value of the all-round man, we meet with the argument that whereas it may be desirable to maintain a staff of specialists in a large factory, the salaries of such a staff would swallow up all the profits of a small one. But this is merely to admit that the small factory is an economic failure, which must be remedied by amalgamating several neighbouring factories under one expert staff or, better still, by abolishing the small factory entirely. Clearly, the same necessity for economic working exists whatever be the size and output of a factory, and it frequently happens that the delapidated condition of the machinery in a small factory will give an engineer much more work than the modern plant of a large central usine. If it is false economy to engage one engineer where three are really required, what sort of

economy would that be which expects him to do the work of the engineer, the pan boiler, and the chemist?

But the demand for the all-round man must surely have a more rational explanation. Although inferior as a worker, his varied experience may be of value to the controller of labour. The manager of an estate may be an agriculturist or merely a business man, but if he is to be the captain of his ship he must know a good deal about the work going forward. In his case, a little knowledge need not be a dangerous thing if estimated at its true worth, and he should be able to enter into the problems of the expert even though incompetent to assist him, or to suggest experiments which, in competent hands, might lead to material progress. In this respect, he may be likened to the general medical practitioner who, when in doubt, calls in the specialist. Differences of opinion may, and frequently do, occur; but if mutual co-operation is thus hindered the fault may always be traced to individuals, and is therefore easily remedied.

Since the rise and development of the beet industry, sugar production has become a combination of industries, in which expert knowledge is an essential condition of progress. Where this is not recognised the cane industry will continue to struggle along at a disadvantage. The attempt to combine administrative and financial abilities with technical expert knowledge in a single brain is as hopeless a task as that of finding the ideal "marine" who will take a man-of-war into action single-handed.

But, although the demand in question may mean a lack of competent men to control the industry, it must be remembered that the Jack-of-all-trades is essentially a worker and rarely lays claim to those qualifications which make a competent controller of labour. He belongs to the past, and if he still survives in the cane industry it is only under conditions where economic production is impossible.

One other aspect of this question may be briefly referred to. What inducement does the cane industry offer the specialist to abandon his craft for that of the manager of an estate? The professional man would hardly devote the best part of his lifetime to his craft if he did not expect to make his living by it, and if this is not possible in certain quarters he will naturally carry his stock-in-trade to other markets.

The American Reciprocity Treaty with Cuba does not seem to be answering expectations. During 1903 only 30% of Cuba's imports came from the United States. Apart from this, Cuban sugar has been sold at about three-tenths of a cent per lb. below the parity of European Markets, owing to the fact that they have only one market for their sugar, the United States, and it has not been able to take up all the available sugar till just now.

MAURITIUS.

A Plea for Social Reform.

The foreign bounties on beet sugar having now ceased, there is once more a free field for the best and richest of saccharine plants—the sugar cane; and the tropical possessions of the British Empire have in consequence a very fair chance of recovering their former prosperity. Whether the loss of their trade was due solely to the foreign bounties or to other contributory causes, such as the extravagance of former planters who left encumbered estates to their successors, the neglect to improve the cultivation and manufacture, or labour difficulties, need not now be discussed. Such loss is common to all the British tropical colonies, to only one of which, viz., to Mauritius, it is sought on this occasion to draw the attention of the readers of *The International Sugar Journal*.

A detailed description of the climate and topography of the island will be found in any good cyclopædia, but the chief points germane to the present subject are its liability to cyclones and its exposure to winds from the southern ocean, which although involving a heavy rainfall, varying from 120 to 60 inches, cause the mean temperature to be lower than that of the West Indian colonies in corresponding latitudes and therefore to retard the growth of the cane—the twelve or fifteen months required in the West Indies to bring the plants to maturity being prolonged to eighteen months, and in some cases to twenty-four months. The island presents the appearance of a high undulating table-land, diversified by rugged and abrupt peaks—the watershed running from N.E. to S.W. at an elevation of from 1500 to 1800 feet, broken by many streams of torrential character flowing through deep gorges. The soil is volcanic, and of considerable fertility; but great improvement could be made by a proper system of land drainage, water storage, and the replanting in part at least of the forests which formerly covered a considerable portion of the higher ground. This would in combination with good sanitation do much to diminish the malarial fevers and dysentery which are unhappily very prevalent throughout the island.

The chief impediment to the progress of the country is however to be found in the character—mental, moral, and physical—of the creole section of the population, which is of the more importance inasmuch as it holds the greater portion of the land and nearly all the political power. The creoles, or native-born inhabitants of French descent, are derived from the French colonists who settled in the island early in the 18th century, cultivating the soil by slave labour (imported from Madagascar and the Mozambique coast, and recruited by importation) until the abolition of the slave trade. During the struggle between England and France for the possession of India considerable additions

were made to the white population, but on the cessation of hostilities very little fresh blood came from France, and inbreeding became frequent. A large class of half-castes naturally came into existence, and in many instances debased the blood of the old French settlers. For some time, however, the planters continued to flourish, and deservedly acquired the reputation (which, to some extent, they still retain) of enterprising sugar growers and manufacturers. During the revolutionary troubles France neglected this colony, which was soon captured by the English, who did not, however, interfere with the local customs or administration, and from then till now the government of Mauritius has been carried on in the interests of the creole inhabitants. The deficiency in labour caused by the emancipation of slaves in the British colonies was soon supplied by the introduction of Indian coolies, who have since steadily increased until the creoles only amount to about one-third of the population, viz., about 112,000 creoles to 264,000 coolies, either Indian or of Indian descent; but the creole French dialect, with some small admixture of Indian words, continues notwithstanding to be the current language, and the creoles retain the greater part of the land as well as the political ascendency. They have, however, much degenerated, being little recruited by new blood, and breeding in and in for at least the last hundred years. The strong family feeling inherent in the Latin races has, amongst the creoles, sunk literally into a vice, and this clannishness is exemplified by endeavours to exclude foreigners, superior ability and honesty notwithstanding, from public and private employ even at a loss to themselves. The active and alert Frenchman has become ignorant, lazy, corrupt, and boastful. To a creole Mauritius is the centre of the universe, and nothing creditable can be done by any one else; but curiously enough there is a strong feeling of mutual distrust among themselves. Too much trouble to work, better to beg than to cheat, better to cheat than to work, seems to be the rule among the lower class. Only a few months ago the Arab merchants bought up the sugar crop piecemeal, and then put the prices up; the planters did not combine for mutual protection, even so far as to employ an agent at Bombay (the principal market) to watch the prices,—they distrusted each other too much for that; but they asked the Government for help! When the "sura," or murrain, destroyed all the draught animals in the country two years ago, the Government negotiated a loan in England at low interest to replace the deceased cattle by trams and traction engines, but although favoured by the largest crop ever known, the planters were not too proud to request that the first instalment of interest might be postponed. Several of them actually paid large dividends, meantime omitting to provide for current liabilities, and went into liquidation next season. Such acts are unfortunately common to all countries, and elsewhere are rare and subject to reprobation, but in Mauritius

not so. The unbusinesslike and unworkmanlike habits of creole manufacturers, tradesmen, and artisans are only too notorious, with, of course, a few exceptions. The very engines bought out of the "sura" loan are rapidly becoming useless from the sheer neglect of the drivers, and it is within the personal experience of the writer that not six of the numerous traction engines were kept in good workmanlike order.

The race also suffers not merely from the inbreeding already alluded to, but from the general neglect of sanitary precautions (partly due to the venality of the lower members of the medical profession); the physique is low and soaked with malaria. The women take very little exercise and age rapidly. The future is easy to foretell unless stringent measures be taken to combat the evil which has gone so far as to render it doubtful whether any enemy can arrest the decay, and whether it would not be more to the point to discuss means for the substitution of a stronger breed of colonists for the effete creoles. These people now possess three-fourths of the land, fill the services and the learned professions, supply a large number of the manufacturers, shopkeepers, and artisans,* and constitute about one-third of the population.

The remaining two-thirds are immigrants from India, usually from the Malabar coast, chiefly cultivators, small artisans, and shopkeepers; they also hold some land, but they are very inferior cane growers unless under European supervision. There are also a few Chinese shopkeepers, and a small and wealthy body of Arab merchants, who manage the greater part of the sugar trade with Bombay; of the English, the military force and higher officials excepted, there are not 200 in the island—chiefly merchants and managers of banks, factories, and plantations, but few as they are, they form the bone and sinew of the local commerce.

The country is administered by a Governor and Executive Council, with a Legislative Assembly consisting of eight ex-officio members, nine nominated by the Governor, and ten selected, the nominees having hitherto been allowed to vote as they pleased. The Indians although out-numbering the creoles by more than two to one are practically unrepresented in the legislature. The civil service is much over-manned and very corrupt. The railways, which belong to the State, and were built by English engineers and contractors, and worked by a staff chiefly European, have by the gradual substitution of Mauritians for English drivers, guards, foremen, &c., in the working of the lines, become much deteriorated—servants are warned of visits of inspection, customers give bribes for dispatch and preferential treatment, and great waste in fuel and repairs arises from careless treatment of machinery and lax superintendence. The lines are

*Under English superintendance creoles make very tolerable workmen, but require very strict supervision.

indeed fairly profitable, for in the absence of draught beasts the greater part of the traffic of the island passes over the railways, but the returns ought to be much larger, and the expenses much less. The above remarks *mutatis mutandis* apply still more strongly to the municipal business. Only last year the Mayor of Port Louis being sued for illegal acts charged the expenses of his defence to the municipal funds, and, although compelled to repay the amount, was neither removed nor called upon to resign. The Supreme Court is pure, but the same cannot be said of the inferior magistracy nor of the lower rank of officials; many also of the business men are tarred with the same brush. It is not that the whole of the creole population is corrupt, but a dangerously large proportion is so—there is venality, weakness and nepotism in the upper class, laziness and carelessness in the lower. Indians are slowly replacing creoles, though the land laws make the process of eliminating the encumbered estates very tedious. It is impossible to do justice to the soil until the large number of embarrassed proprietors is cleared off or greatly diminished, and until this is done much progress cannot be expected. These remarks, harsh as they may seem, are the result of close observation, and are concurred in by all the British residents. In short, the people are unfit for self-government—the creoles for the reasons already given, the Indians from their oriental race and breeding, and the government most suitable under the circumstances is a firm, honest and benevolent despotism.

The financial position so far as it is under direct English management is good, the public debt, with the exception of the "sura" loan previously referred to, being about £1,200,000, chiefly spent in the construction of railways, public works, and repairs of damages caused by hurricanes, and steadily reduced by a sinking fund. The revenue, which usually meets the expenditure, has for the past four or five years averaged about £600,000 per annum. There is also a municipal debt of about £145,000. The financial position of the planters is on the whole unsatisfactory owing to heavy debts on the properties and to unbusinesslike habits. The chief product is, of course, sugar, the planting and manufacture of which is carried on with good machinery on a large scale and on sound traditions, subject, no doubt, to personal defects above mentioned. The creoles seem to have a natural aptitude for the trade, while the coolies, though reliable workers under supervision, are wedded to obsolete methods when planting on their own account.

As has before been said, what the Island above everything requires is an honest, strong and benevolent despotism, and this it is likely to acquire in Sir C. Boyle, the present Governor, whose appointment last year reflects great credit on the Colonial Office. A firm, clear-headed administrator and sound financier, his assumption of the government is looked upon by the best men in the colony as

the commencement of an era of reform and consequent material prosperity, and it is to be hoped that Mauritius has now obtained a ruler who, in the true interests of the taxpayer, will not hesitate to override the clamorous opposition of vested interests. It is with much deference suggested that the principal points to which the attention of the reformer should be directed are as follows, in order to secure economy and good government:—

First the reduction of the number of troops—at the present time a battalion of British and two of Indian troops with a body of artillery and engineers, &c., say about 2,700 men form the garrison. Now as the safety of the island will depend upon the navy, the only object of a garrison is to preserve public order. In view, therefore, of the unwarlike character of the inhabitants, a wing of a British regiment and one battalion of Indian troops—the present complement of artillery, engineers, &c., being retained—ought to be a force amply sufficient for the purpose.

Next, the nominated members of the Assembly ought to be made thoroughly aware that their votes must be at the disposal of the Governor in order that he may not be hampered by any resistance of the creoles in favour of vested interests. The number of the elected members will be quite sufficient to secure attention to well proved grievances.

Then the purification of the municipality and the re-organisation of the civil service, railway and public works' departments from top to bottom. Also strict attention to sanitation with the view of reducing and (if possible) stamping out plague, malarial diseases, &c. Hand in hand with this, a system of public works, roads, railways, conservation of water supplies and afforestation should be established. Also a scheme of impartial *secular* education should be initiated, and libraries, museums, with a good scientific department attached through which to afford information to planters, &c. With a view to attracting British capital to the country and increasing the number of English residents, every effort should be made by the Government by legislation to diminish the number of encumbered estates and bring them into the market. It might also be advisable that the Government, through the Crown Agents or otherwise, should keep in constant touch with the sugar interest in England so as to secure the purchase of these lands by men of capital and experience. The introduction in short of Englishmen as owners and managers of estates and also into the railways and general administration, is of paramount importance and should be encouraged by the Government in every possible way. Most of the sugar estates are on a large scale with fairly modern machinery and should, if conducted on business lines and on up-to-date principles, prove very profitable now that the clog of foreign sugar bounties has been removed.

Last, but not least, it would be very desirable to reform the existing tariff by abolishing the numerous customs duties on food, raw materials, and articles used in building, manufactures, agriculture, &c., leaving, and perhaps increasing, the existing import duties on fermented liquors, tobacco, opium, billiard tables, cards, and fireworks, with the addition of a duty on bhang or ganja. Similarly, an excise should be imposed upon fermented liquors, other dutiable articles the produce of the island, and upon licences to keepers of hotels and billiard tables, and to manufacturers and sellers of the above-mentioned dutiable articles, while all other duties and licenses in restraint of travelling and internal trade should be abolished. No doubt these reforms would leave a deficit (partly filled up by the saving on the reduced establishments and cost of the collection on the revenue) which could be met by the imposition of death duties, or a graduated tax on incomes of £100 per annum and upwards. The railways would also produce a larger surplus consequent on improved management, and the repeal of the duties and licenses which must necessarily press heavily upon trade and tradesmen would perceptibly lighten the burdens upon the commerce of the island, and much increase its volume.

In conclusion, the writer may be allowed to express an opinion that at the termination of Sir C. Boyle's term of office (which it is to be hoped will not be unduly circumscribed) a large increase in the prosperity of the Island of Mauritius, and in the comfort and well-being of its people will be plainly visible.

NOTES FROM JAMAICA.

"How has the recent rise in sugar affected Jamaica?" is naturally a question that will be asked. Well, the rise has given a decided impetus to the sugar industry in this island, and planters are extremely glad. One of them has sold his coming crop on a basis of £14 per ton.

Several local merchants have made money out of the business. Some of the planters are very chary about taking contracts for their coming crop, as they expect that prices will go up higher. Common Muscovado is selling locally at 14s. per cwt., and the price to the consumer is ½d. higher than it was at the beginning of 1904. The rise in sugar has, on a whole, been beneficial to the planters of the West Indies.

Mr. J. C. Nolan has been confirmed in his appointment as Protector in England of Jamaica rum from fraudulent imitation. He will have the power, backed by the Board of Trade, to prosecute all persons tampering with rum exported from Jamaica.

Will there be an attempt to corner the output of distilled rum in this island? Vague rumours are about that a syndicate of planters in the western parishes of the island has been formed for this purpose. In one of the daily papers there appears the following note from a well-known planter:—

Savana La Mar, Jamaica.

Dear Sir,—I have decided, after full consideration, to have nothing whatever to do with your "scheme" for getting up a syndicate to purchase and control Jamaica rums.

Further, as you and Mr. Vickers consider it likely (as you told me when you called here) that my refusal may lead to my rums being "boycotted" by the Syndicate, I protest against yourself, towards whose salary I contribute, taking any further steps or identifying yourself with any scheme that may lead to the loss or ruin of any one of your employers.

I shall make any use of this correspondence I see fit.

I am, &c.,
(Signed) EUSTACE GREG.*

J. Nolan, Esq.

Planters in Vere and elsewhere should consider carefully before pledging themselves to a scheme which might prove dangerous in the near future.

In addressing a circular to the planters *re* his appointment in England, Mr. Nolan says in part, "There are two steps absolutely necessary for the planters to take which will materially assist me in tracking down adulterated rums. One is to have samples of rums sent from each estate to Mr. Cousins, the Island chemist, so as to define its component part. By this means we will no doubt be able to 'standardize Jamaica rum'; if such a step could be accomplished it would be of the greatest assistance in prosecutions, and greatly enhance the value of our rums. The next step is to register the trade mark of your estates in the Patent Office, London; this will, I am informed, cost £3."

Kingston, Jamaica, February 1st. All the estate hands are now busy getting in the crop, which is expected to be a record one. While those estates on the north side are now well into the bouting season, the Vere plantations have, figuratively speaking, just commenced. The work of erecting the new machinery on Denbigh Estate is nearly finished, and not very long ago a fatal accident occurred there.

At a meeting of the sugar planters of the north side, held at Falmouth, on the 28th ult., it was decided to form a Northside Sugar Planters' Association, quite separate and apart from the Westmoreland Sugar Planters' Association. The Articles of Association were drawn up, and the following officers were elected:—Hon. L. C. Shirley, President; Mr. Sewell, Vice-President; and Mr. Joseph Shore, Secretary. Some 44 estates in the parishes of St.

* From *Gleaner*, of December 31st, 1904.

Awn, Trelawney and St. James are represented in the Association, from which much good is expected.

The weather during the last month has been variable, sometimes great heat, and other times cold being experienced. On the 28th January a heavy northern gale swept the parishes, but did no damage to the plantations.

The death of Mr. Moulton Barrett, of Trelawney, had to be recorded during the month. In former days the deceased owned several large sugar estates, but latterly he fell on evil times.

The machinery of the Hope Experimental Station has been erected, and is in working order. Samples of rum from various estates have been submitted, and the analysis shows good returns.

THE WEST INDIAN AGRICULTURAL CONFERENCE, 1905.

The Fifth West Indian Agricultural Conference was held in Port of Spain, Trinidad, during the first week in January, under the Presidency of Sir Daniel Morris. A distinguished list of representatives from the various West Indian Colonies attended. The proceedings were opened by the Governor, who extended a hearty welcome to the members of tho Conference. He paid a tribute to Sir D. Morris and his work amongst them, and alluded to the fact that in the periods of worst depression in the West Indies, Trinidad had been able to fight it own battles and keep itself from bankruptcy.

The President, Sir Daniel Morris, K.C.M.G., then gave his address. He said * :—

I have pleasure in presiding at the Fifth West Indian Agricultural Conference. I congratulate you on being able to meet in so important and progressive a colony as Trinidad for the consideration and discussion of problems which lie at the foundation of the material prosperity of these colonies.

Trinidad is possessed of special features as a meeting-place for those interested in agricultural matters, and there is no doubt that we shall, directly and indirectly, obtain valuable information likely to be of benefit in advancing the agricultural interests in which we are severally concerned.

As you are aware, there has been an interregnum of two years in holding these Conferences, caused by quarantine restrictions. It is hoped that difficulties of this kind will disappear as a result of the more scientific and, it is believed, equally effective measures now in course of being adopted.

* For what follows we are indebted to the *West Indian Bulletin*, from which it is abridged.

The prospects of the sugar industry are more favourable than they have been for many years, and it is realised that the West Indies, after the strenuous efforts made in their behalf, have, at last, obtained a position which should enable them to compete, in the British market, on equal terms with all sugar-producing countries.

This Conference will be more favourably placed as compared with previous Conferences, inasmuch as it will be possible to extend the business over a longer period and thus afford opportunity for a fuller consideration of the subjects to be brought before it. It will also be possible to visit several localities of special interest from an agricultural point of view, and afford representatives more time for the mutual exchange of ideas in regard to the possibilities of their respective colonies.

I am glad to find that in point of numbers, as well as in the standing and experience of the members accredited to it, this Conference compares favourably with any of its predecessors. We have amongst us able and representative men who not only possess a direct interest in the welfare of these colonies, but are in a position to speak with authority in regard to the many questions to be submitted for their consideration. We have also present men highly qualified in their special departments, who by their scientific skill and knowledge are capable of dealing successfully with complex and difficult problems and placing the results in a practical form at the disposal of the planting community. It is the cordial co-operation of these two forces (which all along has been one of the main objects of these Conferences) that will make for the ultimate salvation of these colonies. I believe that I am justified in stating that we have now assured to us the confidence and support of all the prominent men who represent the practical side of agriculture. They are working side by side in hearty co-operation with the scientific side, hence the results cannot be otherwise than beneficial and of a lasting character.

The treatment of the diseases affecting crops continues to receive a large share of attention. There is no doubt that in most cases where diseases have made their appearance, and where remedial measures have been immediately taken in hand, the loss to the planter has been either prevented altogether or greatly reduced. Proposals put forward for fumigating plants before they are admitted into these colonies are being generally carried out. This is one of the most effective means for preventing the introduction of insect pests. Disinfecting large importations of seed, as was done in the case of Sea Island cotton seed during last season, is a precaution that deserves to be generally adopted.

At former Conferences a prominent position has been given to proposals for introducing the teaching of the principles of Agriculture in the Primary and Secondary Schools in the West Indies.

The progress in this direction has necessarily been somewhat slow; but, on the whole, sufficient experience has now been gained to enable us to look hopefully as to ultimate success. The information to be placed before us by those who have taken an active part in this work cannot fail to be of interest. It is impressed upon us a matter of daily experience that, until the masses of people in the West Indies are brought into sympathy with agricultural pursuits and are trained from infancy to adopt the successful treatment of the soil as the basis upon which to build not only their own prosperity but the general prosperity of these colonies, we cannot regard ourselves as fully equipped for competition with other countries.

SUGAR INDUSTRY.

From a recent report presented by Professor Harrison in behalf of the Sugar Cane Experiment Committee of the Board of Agriculture, it would appear that the total area under cultivation in British Guiana is 78,003 acres, including 2,500 acres cultivated by small farmers. This is an increase of 11,095 acres as compared with 1896. The average cost of producing one ton of first centrifugal sugar, including 14 per cent. second sugar and 25 gallons of rum, was £10 9s. 2d. in 1903 as compared compared with £11 9s. 2d. in 1896. In 1897 only small areas of land were occupied with canes of other varieties than Bourbon, while at the present time about 14,000 acres are planted with them. The result of experiments on a large scale with seedlings and other canes than Bourbon recorded during the last three years "indicates an increased yield per acre of from 12 to 20 per cent. over that of the Bourbon." The Committee states that this increase has been obtained by the substitution of certain new varieties for the Bourbon cane "without increase in the cost of cultivation and possibly with a lessened outlay for manure." It is added that "in many of the experiments the varieties, other than Bourbon, have been cultivated on land on which the latter cane does not flourish, while the Bourbon returns are, as a rule, from land of average fertility upon which it gives satisfactory returns."

A "Report on the Agricultural Work in the Experiment Fields and the Government Laboratory for the season 1903-4" in British Guiana has recently been issued by Professor Harrison.

The following are the principal varieties of other canes than Bourbon cultivated in British Guiana:—D. 109 (3,338 acres), White Transparent (2,876 acres), B. 147 (1,138 acres), D. 625 (537 acres), and B. 208 (417 acres).

A general summary of the interesting results presented by the Sugar Cane Committee at British Guiana will be discussed later. As confirming what is stated by the Committee and as showing what has been done with seedling canes on a large scale at the Diamond Estate in British Guiana, the Manager states, as the result of

experiments carried on for four years (1901-4 inclusive), that seedling canes grown on an average area of 1,537·918 acres, as compared with Bourbon canes grown on an average area of 2,824·352 acres, have proved better than the Bourbon to the average extent of 24 per cent. The average crop reaped during the period under review was 10,560 tons of sugar. The details on which this summary is based are now before you.

At Barbados during the last five years 20,407 varieties of seedling canes have been raised. Less than 1 per cent. of these have stood the stringent tests of field and chemical selection applied to them. The seedling experiments in hand up to December 31st, 1903, consisted of 8,120 plots covering 143·294 acres. Experiments with manures consisted of 106 plots covering an area of 14·196 acres, while another set of manurial experiments consisted of 18 plots covering an area of 16·02 acres. The general results are favourable and indicate that the efforts that are being made are in the right direction and justify the opinion that the raising of seedling canes affords special promise, as in British Guiana, of increasing the yield and diminishing the cost of cane sugar production in this island.

About 35,000 acres of canes are reaped annually in Barbados. According to a return prepared by Mr. Bovell in 1903, the Bourbon cane, owing to the prevalence of disease, has been almost entirely discarded of late years. The area under cultivation in this cane in 1903 was 328 acres. The area under other canes in 1903 was approximately as follows: White Transparent, 18,566 acres; Rappoe, 3,089 acres; Caledonian Queen, 1,661 acres; B. 147, 1,642 acres; B. 208, 342 acres. The area under seedling canes is gradually extending. The figures for 1904 are not yet available. Of the newer canes the most promising is B. 1,529. The cultivation of this cane (on account of the large yield per acre and the purity of its juice) is being extended to as many experiment plots as possible during the present planting season.

The reason why seedling canes have not been adopted on a larger scale at Barbados is due to the high standard of excellence attained in that island by the White Transparent cane. But every year the results of the seedling experiments show an approximation to the establishment of a richer and more stable variety. In the meantime, the conjoined efforts of the Department and members of the planting community are steadily being directed to the general improvement of the industry.

A pamphlet (No. 32) containing a summary of the last Report on "Seedling and other canes at Barbados, for the year 1903-4," prepared by Professor d'Albuquerque and Mr. J. R. Bovell, is now before you.

In the Leeward Islands Dr. Francis Watts has recently presented the results during the last five years in regard to the introduction of seedling canes and manurial experiments at Antigua and St. Kitt's.

At Antigua there are about 8,000 acres under cane cultivation. The principal varieties are the White Transparent (under which is included Naga B., Mont Blanc, and Caledonian Queen), B. 147, D. 95, and B. 208. The area under Bourbon is reduced to about 204 acres. By means of the introduction of new varieties of canes, Dr. Watts states, "the planter has now an opportunity of selecting his canes for particular soils and situations or for early or late planting. In this way he may not necessarily select that cane which has done best on the average of the whole of the experiments, but his own observation may have led him to see that some particular cane will prove suitable for some special conditions, and he selects suitable canes accordingly."

At St. Kitt's the total area under canes is estimated at 7000 acres. The principal canes cultivated are what are known as the "Jamaica," Caledonian Queen, and White Transparent. The area under seedling cane B. 147 is about 1700 acres and under B. 208 130 acres. The area under Bourbon is about 340 acres.

At one time cane diseases in this island "invaded one area after another until fears were entertained that some estates must be abandoned and sugar growing cease upon them. Following the the advice of the Department of Agriculture those planters whose canes were being destroyed by the ravages of disease introduced other varieties, notably B. 147, with the happiest results: plantations which were in danger of abandonment are now bearing luxuriant crops, to the great relief and satisfaction of their owners."

In summing up, Dr. Watts states:—"It will be seen that the newly introduced varieties of canes, including some of the newly discovered seedlings, have already played an important part in the sugar industry of the Leeward Islands. The work of their introduction is highly regarded by planters, who freely express their appreciation of the advantages they have derived, and the feeling is now engendered that in the selection of varieties of cane they are in possession of a powerful defence against many forms of cane diseases."

A pamphlet (No. 33), containing a summary of the results of the cultivation of "Seedling and other canes at the Experiment Stations in the Leeward Islands during the year 1903-4," is in the press and will be issued shortly.

At Trinidad the Otaheite or Bourbon cane is generally cultivated. Owing to the absence of serious disease and to the generally good results obtained from the present canes, systematic experiments on large estate scale with seedlings and manures have apparently not been regarded as a necessity, as in the other colonies. Seedlings raised locally, or obtained from elsewhere, have been grown for some years at St. Clair Experiment Station, and the canes analysed by the Government Chemist. The recent results are published in the *Proceedings* of the Agricultural Society and the *Annual Reports* issued by the Botanical Department.

At Jamaica during the last three years Mr. H. H. Cousins has undertaken manurial experiments on estates on a fairly large scale. The results have shown that Jamaica soils are generally well suited for cane cultivation. About eighty selected varieties of cane are being grown at the Experiment Station at Hope for distribution. It is now proposed to inaugurate a scheme of sugar work on a large scale. A law was passed by the Legislature in August, 1903, by which the Imperial grant-in-aid of the sugar industry (£10,000) was appropriated for the maintenance, under the direction of Mr. Cousins, of Experimental Stations with special reference to the chemistry and mycology of sugar and rum. A fermentation chemist has been appointed in connection with the rum investigations. The grant is estimated to provide for research and experiment work for six years.

In regard to the sugar cane experiments carried on in the West Indies, it may be mentioned that the numerous publications issued, as well as the new canes raised, appear to be highly valued in other countries. For instance, the Director of Sugar Cane Experiments at Hawaii states that "cane D. 117 yielded from a ton to a ton and a half more sugar to the acre than any other variety under trial." In Cuba Mr. E. F. Atkins, of Grand Soledad, reports that cane D. 95 gave highest polarization and purity. B. 208 (from short second plants) led in this respect, but was deficient in juice. Mr. Robbins, of Port Douglas, Queensland, mentions that B. 147 headed the list, yielding 23·40% of "possible obtainable crystallizable sugar" from ratoons. In Louisiana the best seedling canes in experiments carried on by Dr. Stubbs were D. 95 and D. 74.

The exports of selected cane tops from Barbados are considerable: a recent set of shipments to a neighbouring island consisted of 20,000 plants.

The discussion on results of recent experiments with "Seedling Canes and Manurial Experiments in the West Indies" was opened with a paper read on behalf of Professor J. B. Harrison, C.M.G., by Mr. E. W. F. English (British Guiana).

It was stated that 14,000 acres were occupied in British Guiana with varieties other than the Bourbon, and of these about 12,000 acres were being cultivated in new seedling varieties, the favourite varieties being D. 109, B. 147, D. 145, D. 625, and B. 208. In late years nearly one-third of a million tiny canes had been raised and 26,000 of these had been selected for field experiments. From these a few hundreds had been selected for continued experiments, and from these again the planters had selected some fifty varieties as being of possible value to them, and of that fifty some dozen or so showed promise of being of actual value agriculturally. There were indications that among the latest selection of seedlings were large-sized varieties of very high saccharine content. Practically every

estate in the colony carried on small-scale experiments. But there was also a system of large-scale experiments which gave much more reliable results.

With regard to the manurial experiments, it would appear that the general principles were applicable not only to the Bourbon variety but also, probably, to all the new varieties submitted to experiment. The objects have been to determine the effects of the manurial constituents of plant food upon the yield of the sugar-cane, and to determine, if feasible, the effect of tillage, manuring and cropping upon the proportion of the readily assimilable constituents.

Professor J. d'Albuquerque (Barbados) followed with a paper dealing with the results of the experiments carried on in Barbados. He referred to the pamphlet containing a summary of the results obtained in the experiments with varieties, which had recently been issued and which was in the hands of the members of the Conference. B. 208 was still in favour with planters, and one of the newer canes, B. 1529, had given very promising results. The principal results were indicated on the diagrams which were hung on the wall.

Dr. Francis Watts (Leeward Islands) gave a similar account of the experiments that had been carried on in Antigua and St. Kitt's. The full report of these experiments was in the press and would shortly be issued. Some of the varieties had shown a greater power of resistance to disease and drought than others. The charts on the walls showed clearly the results that had been obtained with various manures.

Dr. Urich, Analyst and Technical Chemist to the Trinidad Estates Co., Ltd., read a short paper on the comparative yield of the Bourbon cane, White Transparent, and D. 95 at Brechin Castle estate, Trinidad, 1904. The results were obtained on the large area of 1,762 acres, and were, therefore, of considerable interest. D. 95 had given an average return of 23·65 tons per acre, of against an average of 21·23 tons per acre for White Transparent, and 16·43 tons per acre for the Bourbon. Dr. Urich was accorded a hearty vote of thanks for his paper.

In closing the discussion, the President said it was too soon to generalize except to this extent, that seedling canes appeared in most instances to prove of very considerable value to the planters and to flourish under conditions unsuited to the Bourbon cane.

The subject of Cane Farming in British Guiana and Trinidad was then taken up.

The Hon. B. Howell Jones gave details of the cane-farming industry in British Guiana, mentioning some of the difficulties which had had to be overcome in the beginning; these were partly connected with transportation, and partly due to suspicion on the part of the labourer. The latter difficulty had been overcome by Mr.

Scard who prepared a sliding scale of payment for canes which had been accepted as a standard.

Professor Carmody dealt with the industry in Trinidad, giving statistics which showed that the industry had progressed and was now an established and important branch of the sugar industry. He concluded by making various suggestions for the improvement of the position of cane farmers.

The Hon. S. Henderson also addressed the Conference on this subject and gave certain facts and figures supplied by Mr. Peter Abel with regard to the cane-farming industry in the Naparima and Pointe-a-Pièrre districts between 1885 and 1904. These showed that the tonnage of canes per acre obtained by cane farmers was being greatly reduced through want of cultivation and exhaustion of the soil.

His Excellency the Governor gave an interesting description of a system of cane farming which had given good results in Fiji. It was called the 'share' system or 'cane company' system. This was working so satisfactorily that the General Manager of the Colonial Sugar Refining Co., of Sydney, in whose hands practically the entire sugar industry of Fiji is placed, recently stated that he looked forward to the time, not immeasurably distant, when they would be able to reduce very largely indentured labour. A vote of thanks was accorded to his Excellency by the Conference.

Mr. L. Lewton-Brain (Mycologist on the staff of the Imperial Department of Agriculture) then read a paper briefly reviewing the principal fungoid diseases of the sugar-cane, with special reference to the rind disease (*Trichosphaeria sacchari*), the pine-apple disease of cane cuttings (*Thielaviopsis ethaceticus*), and the root disease (*Marasmius sacchari*).

The subsequent discussion showed that the rind disease was prevalent in many parts of the West Indies, but was practically confined to the Bourbon cane.

Mr. H. A. Ballou (Entomologist of the staff of the Imperial Department of Agriculture) reviewed the insect pests of the sugar cane. He dealt especially with a new pest that had made its appearance on one estate in British Guiana and was doing considerable damage. The insect may be known as the Larger Moth borer or *Castnia* of the sugar cane.*

Mr. A. W. Bartlett and Mr. Howell Jones added certain information with regard to the outbreak of this pest.

Dr. Watts (Leeward Islands) read a paper on the "Field Treatment of Cane Tops for Planting Purposes." He described the experiments conducted at Antigua, on the treatment of cane cuttings with

*It has been identified as *Castnia licus*, Drury.

germicides. The experiments consisted in treating the cuttings with Bordeaux mixture, in tarring the ends, and in a combination of these two methods. The results were of a decisive character and tended to show that Bordeaux mixture was an efficacious agent in preserving the cuttings; tarring the ends had also a beneficial effect, though less marked. The use of Bordeaux mixture in conjunction with tar produced very slightly better results than with Bordeaux mixture alone, but the slight gain did not warrant the extra expenditure on the tar. Bordeaux mixture was being fairly extensively used in this connection at Antigua.

This subject was discussed by Mr. Howell Jones (British Guiana), Mr. Abel, Mr. Henderson, and Mr. Fenwick (Trinidad), the opinion being expressed that on large estates with several thousand acres under canes the number of tops were too great to admit of their being treated. Dr. Watts replied that the magnitude of the operations could not be regarded as a barrier.

Dr. Watts (Leeward Islands) then read a paper prepared by himself and Mr. H. A. Tempany (Assistant Chemist) on the "Polarimetric determination of Sucrose." The paper contained suggestions for securing greater accuracy and uniformity in results in work connected with sugar-cane experiments.

A further paper by Dr. Watts on the "Central Sugar Factory in course of being erected at Antigua" was then read. He described the circumstances which had led up to the erection of the factory, and briefly stated the position of affairs at the present time. The capital of the Factory Company was £40,000, including the £15,000 contributed by the Government. The Company agreed to erect a well-equipped factory capable of making 30 tons of 96° crystals in a day of twenty-three hours. It also agreed to purchase canes from peasant proprietors and others at prices to be regulated by a sliding scale fixed beforehand.

Messrs. John McNeil & Co., Colonial Iron Works, Glasgow, the well-known Sugar Machinery Engineers, have just recently shipped a 34-in. mill, engine, and gearing to Queensland. This mill is of very heavy proportions, the roller shafts having journals 17 in. diameter by 22 in. long, with an engine 35 in. by 48 in., and gearing having pinions and wheel rims all of cast steel. The whole plant supplied weighed over 160 tons, and the order which was received on the 18th December, 1904, was completed on the 24th February, 1905, which, allowing for New Year holidays, implies the remarkably short space of eight working weeks. The mill was built under the inspection of Mr. Claude T. Berthon, Consulting Engineer, 49-51, Eastcheap, London, E.C., to the order of his clients Messrs. Young, Bundaberg, Queensland.

VARIETIES OF CANE.

By F. C. Eckart.*

Probably no subject pertaining to the cultivation of cane in the Hawaiian Islands during recent years has held more interest for the planters, in various localities, than that relating to the introduction and trial of new varieties.

In the Hilo and Hamakua districts, the Lahaina first made way for the Rose Bamboo, and the latter, after a strong stand for many years, is now being rapidly succeeded by the more vigorous Yellow Caledonia. This cane with its upright growth and deep rooting propensities has proved a most valuable acquisition in wet and dry localities alike. Growing erect, with a natural tendency to shed its dried leaves, it becomes an admirable cane for rainy districts, where varieties that are prone to fall to the ground and remain in contact with a frequently saturated soil have shown extreme sensitiveness. The frequent stripping, required for Lahaina and Rose Bamboo in these wet places, has necessarily added to the cost of cultivation, and the ready manner in which Yellow Caledonia tends to strip itself is no small item in favour of economy. Again the manner in which it keeps down weeds, which were such a menace to its predecessors on the unirrigated plantations, is another strong point in its favour. In dry districts subject to occasional drought, it has amply demonstrated its hardihood over Rose Bamboo, which in turn is more resistent to such unfavourable climatic features than Lahaina. By sending its roots down deep into the soil it draws from a larger reserve supply of water than the older varieties, which are more shallow feeders and which soon feel the effect of a rainless period.

The substitution of hardier varieties, in localities subject to varying and adverse weather conditions with their train of insect and fungus depredations, as well as the constant aim to produce a cane of higher sucrose content, less fibre, and superior milling qualities in more favoured regions, has formed a subject for continued investigation in nearly all sugar growing countries. Within the past ten years we note the passing of Rappoe (our Rose Bamboo) in certain districts of Queensland, where through gradual deterioration it finally reached a stage when it could no longer cope with diseases from which it had previously suffered but little damage. In 1890 the Bourbon (identical with the Lahaina), which had grown for many years as the standard variety of Barbados, began to be replaced by varieties which showed a greater resistance to disease and insect attacks, and we note a favourable report concerning Caledonian Queen, Striped Cane, Queensland Creole, &c., with regard to their immune character-

*Experiment Station and Laboratories of the Hawaiian Sugar Planters' Association. Press Bulletin No. 1.

istics. To-day a superior variety and a seedling has come to the front under the name B. 147, and has become firmly established as the standard cane of Barbados and other points in the West Indies.

The introduction of new varieties into the various sugar-growing countries in the world, while attended with profitable results in many instances, has given rise to considerable confusion regarding their nomenclature. Often, on becoming established in their new homes, the canes receive local names, which in time entirely replace those under which they were imported. A signal success with one of these newly introduced varieties, under its new environment, results at times on its being returned, on request, to the country in which it originated, under the impression that it is a new cane with valuable qualities, and consequently worthy of trial. Naturally this change of habitat is productive of certain modifications in the cane, which, though superficial in some instances, cause it to be grown for many years along side of its near relative, descended from the same stock, before it is identified as the same variety. We thus find our Lahaina passing under the name of Bourbon, Colony Cane, Otaheite, Loucier, Portier, Bamboo ii, China ii, and Cuban. The Rose Bamboo has received the appelation of White Transparent, Caledonion Queen, Blue Cane, Light Purple, Rappoe, Mamuri, Hope, and Light Java.

It is interesting to note the changed characteristics of the same variety after having been subjected to different soil and climatic influences during many years. For instance, if we endeavour to trace back to their original ancestors our Lahaina, introduced into these islands from the Marquesas Group by Captain Pardon Edwards, and the Otaheite, received from Louisiana some years ago, it appears that they came from the same stock. From the coast of Malabar, India, this variety (for they are the same) was shipped to Reunion, Mauritius, and Madagascar, and from these points it was received by the West Indies and the islands of the Pacific. From the West Indies "Otaheite" was introduced into Louisiana and from Louisiana into Hawaii, while the "Lahaina" came from the other direction and reached Hawaii by way of Marquesas. When brought together at the Experiment Station and grown side by side under the same conditions of soil, climate, irrigation, and cultivation they resembled each other closely and only differed in their value as sugar producers and in the diameter of the stick. A comparison of these canes at the Station may be shown by the following figures:—

	Lahaina.	Otaheite.
Cane per acre	116,015 lbs.	120,516 lbs.
Sugar per acre	18,377 lbs.—	13,450 lbs.
Fibre	11 %	10 %
Brix of juice	19·62	15·07
Sucrose of juice..	17·8	12·4
Purity of juice	90·72	82·28

In 1903 a small lot of Otaheite was harvested which made a somewhat better showing than the above.

The difference in yields and other characteristics, manifested by the same cane under different climatic conditions, indicates forcibly the necessity of experimenting with a variety in as many localities as possible before it is condemned as a poor sugar producer in these Islands. This point is brought out most clearly in the case of the Yellow Bamboo, which thrives at high elevations in Kau and at a point where Lahaina would prove a failure. At the Experiment Station, on a low level with corresponding differences of soil and climate, the Yellow Bamboo produces only one-half as much sugar as Lahaina. Another good illustration of this point is amply afforded by the Salangore variety. In the Straits Settlements, after being tried in competition with many varieties, it was found to take the lead with Lahaina standing second. Grown at the Experiment Station in Honolulu, Salangore, made but a poor showing compared with other canes, and owing to the limited area of land was dropped from further trial in order to make room for more promising canes.

SALANGORE AT THE EXPERIMENT STATION.

Cane, per acre	95,832 lbs.
Sugar, per acre	13,081 lbs.
Fibre, in cane	11·37 %

JUICE ANALYSIS.

	Per cent.
Brix	17·67
Sucrose	15·4
Purity	87·15

Climate and soil are the paramount influences exerted on the sugar producing capacity of different varieties, and of these two conditions it is difficult at times to note which has the more determining effect on crop production. At a central station where varieties are grown on the same soil, a different order as regards their yields is often manifested from year to year, and if attention to this change in the scale of production is supplemented by a careful comparison of weather conditions during separate periods, an indication is afforded as to the localities in which certain canes may profitably be tried. Another cause which tends to change such an order among varieties is the difference in the rapidity in which canes become acclimated. One which becomes adapted to its new environment more quickly than another, is not necessarily going to hold a superior position over the other when it in turn has gradually become accustomed to its new home.

A difference in the time of maturing may also prove prejudicial to the showing some varieties may make when grown in competition

with others, and this point is worthy of consideration. For instance, if we cut all of the varieties at one time (as is usually done) for the purpose of comparing their relative productiveness, some of them which matured earlier than others may be already "going back" as we say, and this brings them into unfavourable comparison with the more slowly maturing canes. Demerara No. 95, for instance, has been observed to deteriorate rapidly after it has become fully ripe. This difference in the rate of maturing must also affect in some measure the vitality of the seed cuttings. For instance, if we are growing a dozen varieties for seed to be planted out in competitive plat experiments, it can readily be seen if these are cut at a certain age (say at 11 months). Some varieties will furnish more mature cuttings than others, and consequently the eyes germinating with different degrees of vitality will influence the ultimate yields of sugar.

Such considerations as the above make it necessary that varieties shall be grown in competition through a number of seasons before we attempt to draw conclusions as to their relative worth and take one from among the rest as a standard cane.

At the Experiment Station a number of varieties were recently harvested, and the weights of each were taken from an area sufficiently large to indicate their respective merits under such conditions as obtained at the Experiment Station during 1902-3. The yields were as follows:—

Variety.	Sugar per Acre. lbs.
Demerara, No. 117	26,540
Cavengerie	25,955
Striped Singapore	22,661
Queensland, No. 1	21,878
Yellow Caledonia	21,808
La. Purple	21,232
Queensland, No. 7	21,100
Big Ribbon	19,812
Demerara, No 74	19,354
La. Striped	19,067
White Bamboo	18,604
Tiboo Merd	18,044
Queensland, No. 4	15,996
Demerara, No. 95	15,158
Queensland, 8A	14,622
Gee Gow	14,402
Yellow Bamboo	12,307

THE FIBRE STOOD AS FOLLOWS:—

Variety.	Fibre. Per cent.
Cavengerie	12·7
Gee Gow	12·2
Tiboo Merd	10·0
La. Striped	10·0
La. Purple	9·8
Queensland, No. 1	10·75
Queensland, No. 4	11·0
Queensland, No. 7	12·5
Queensland, SA	11·0
Demerara, No. 74	9·8
Demerara, No 95	11·1
Demerara, No. 117	11·5
Yellow Bamboo	12·3
Yellow Caledonia	11·1
Big Ribbon	11·3
Striped Singapore	10·3
White Bamboo	13·1

ANALYSIS OF JUICE.

Variety.	Brix. Per cent.	Sucrose. Per cent.	Glucose. Per cent.	Purity. Per cent.	Gums. Per cent.
Cavengerie	18·14	15·8	·752	87·1	·60
Gee Gow	17·76	16·1	·301	90·7	·39
Tiboo Merd	16·23	13·9	1·044	85·6	·44
La. Striped	17·56	15·9	·413	90·5	·45
La. Purple	17·11	15·5	·381	90·6	·48
Queensland, No. 1	16·13	13·9	·978	86·2	·57
Queensland, No. 4	16·33	14·2	·845	87·1	·54
Queensland, No. 7	18·98	16·8	·205	88·5	·85
Queensland, SA	16·91	14·8	·339	87·5	·51
Demerara, No. 74	16·47	14·2	·404	86·2	·56
Demerara, No. 95	17·43	15·7	·324	90·1	·42
Demerara, No. 117	17·16	15·2	·459	88·5	·52
Yellow Bamboo	16·99	14·7	·472	85·9	·56
White Bamboo	18·54	16·1	·288	86·8	·72
Yellow Caledonia	18·74	16·2	·325	86·9	·74
Big Ribbon	17·29	14·7	·549	85·0	·64
Striped Singapore	17·36	15·5	·563	89·3	·48

Demerara No. 117 still holds the lead among the recently introduced varieties, and is a promising cane worthy of trial under the diversified conditions of the Islands. Yellow Caledonia, Demerara No. 74, Cavengerie, Striped Singapore, Queensland No. 1, and Queensland No. 7 also produced heavy yields. White Bamboo, Queensland No. 7, Yellow Caledonia, and the unstriped cane which occasionally appears in a stool of Big Ribbon are closely allied; in fact between White

Bamboo and Yellow Caledonia there appears to be no difference, and after four years' trial it is impossible to distinguish one from the other.

The following new varieties will be planted out in June of this year and will be harvested in 1906:—

Striped Tip,	Demerara No. 1937,
Daniel Dupont,	Queensland B. 5,
Demerara No. 115,	Queensland B. 8A,
Demerara No. 116,	Queensland B. 147,
Demerara No. 145,	Queensland B. 156,
Demerara No. 1135,	Queensland B. 176,
Demerara No. 1483,	Queensland B. 208,
Unknown,	Queensland B. 244,
Dark Coloured Bamboo,	Queensland B. 306.

Some of these are very promising canes and have a noteworthy reputation in other countries, chief among them being: D. No. 115, D. No. 145, B. No. 147, B. 156, and B. 208. Regarding B. No. 147 one West Indian planter writes: "B. No. 147 has the inestimable advantage of being a rough cane outside, with a tough rind, and covered with a coating of dry leaves, which, however, drops off readily when the cane is fully ripe or cut. A spot of this cane which was lately cut for plants, was remarkably free from the common cane borer of which it was very difficult to find a single specimen."

If B. No. 147 sustains its reputation when tried in Hawaii, it will certainly prove a valuable acquisition in some localities.

All of the varieties mentioned in this bulletin as having been cropped during the present year and those which will be planted in June, will be grown for seed for distribution in the spring. It is believed that some of them will be found of value when grown under the various Island conditions.

QUEENSLAND.

The Sugar Experiment Stations.

The Annual Report for the year 1903-04 of the Bureau of Sugar Experiment Stations in Queensland has been lately issued. It points to steady and painstaking work on the part of Dr. Maxwell and his assistants.

The work of the laboratories has been largely taken up with analyses of soils and water. Some 824 samples of the former were dealt with, and about 200 specimen of irrigation water. The result of the testing of the waters was to show "the extreme variation in quality and in suitability for irrigation uses of the waters that are submitted for the laboratory's determinations." The analyses make it very clear that waters cannot be used indiscriminately for plant nutrition. The Report states:—

"The minerals which render waters unfit for irrigation, when these bodies are contained in excess, are common salt and chlorides of

magnesium, potassium, &c., and also the carbonates of soda and related salts. It has been stated repeatedly by the writer that there is not any economic means of rendering highly-mineralised waters suitable for irrigation, and that the only practical means of lessening the severe action of the chlorides of sodium and magnesium upon plant life is the free use of lime. Experiments with saline waters, in great detail, carried out by Director C. F. Eckart, Honolulu Sugar Experiment Station, have fully confirmed all that has been said thereon. The only means of protection is the use of waters whose saline contents do not exceed a given amount, or which does exceed a certain 'danger point.'

"There is, however, no such thing as an absolute danger point. The point of danger is governed by the saline contents of the soil as well as those of the water. Soils with a minimum content of soluble, pernicious salt can bear a water with a higher content of salts than soils that are already more or less charged with chlorides or carbonates of soda or magnesium. A standard for general guidance has to be adopted, however; and, while Director of the Hawaiian Experiment Station and engaged with irrigation questions in that country, the writer was led to adopt 100 grains of common salt per gallon as the 'danger point," and repeated tests carried out by Mr. Eckart in the same conditions have very generally tended to conform the advisability of that standard, which is now adopted in the present considerations."

Some experiments were undertaken to show the preserving action of lead acetate, mercuric chloride, and formalin. The results individually, and in average, indicate conclusively that mercuric chloride is the most effective. These results relate exclusively to preservation, and not to the clarification of the juice for analysis. Lead acetate was applied as a preservative at the rate of 4 c.c. to 100 c.c. of juice; mercuric chloride, ·01 grm. to 100 c.c. of juice; and formalin 1 c.c. to 100 c.c.

EXPERIMENTS TO DETERMINE THE PRESERVING ACTION OF DIFFERENT CHEMICALS UPON CANE JUICE.

Original Analysis.		Lead Acetate.			Mercuric Chloride.			Formalin.		
		After 16 hours	After 40 hours	After 72 hours	After 16 hours	After 40 hours	After 72 hours	After 16 hours	After 40 hours	After 72 hours
	Per cent.									
Brix,	19·410	..	..	..	19·380	19·330	19·320	19·380	19·360	19·320
Sucrose,	18·157	18·321	18·239	18·232	18·163	18·183	18·135	17·960	17·892	17·829
Glucose,	·249	·253	·250	·250	·253	·265	·277	·285	·322	·323
Purity,	93·590	..	..	..	93·820	94·060	93·960	92·670	92·410	92·280

Work of the Experiment Station.

"The experimental work of the station has been continued, and upon the lines established and set forth in preceding reports. This work embraces cultivation, manuring, irrigating experiments, and competitive tests with all varieties of cane that may turn out to have a commercial value for the industry.

"*Ratoons of the Rose Bamboo Variety.*—The experiments of last year in cultivation and fertilising were continued with the first ratoon crop of the Rose Bamboo variety. Unfortunately, in December of last year the disease known as cane rot began to appear in this cane, and continued to cause damage right up to the harvesting of the crop. As a consequence, the competitive and experimental value of the different plats was destroyed, and it is now only attempted to give the general results, and not to draw any conclusions from the experiments of a special nature.

"The total yield of cane from the 42 plats, covering 3·1 acres, was 59·21 tons, or an average of 19·1 tons per acre. After delivery of the sound cane to the mill, the rotten cane found upon the ground amounted to 28 loads, representing not less than some 35 tons of cane had it remained sound. The cost of production was £13 17s. an acre, and is stated as a close approximation only, the actual cost, on account of the diseased cane that had to be removed, being very difficult to decide. The value of the Rose Bamboo ratoon cane delivered at Meadowlands Mill amounted to £52 6s., including the federal rebates, being equal to £16 17s. 5d. per acre, thus leaving a balance over cost of production of £3 0s. 5d. per acre.

"These figures state the results of the crop consequent upon the disease which attacked it. Had the crop remained sound and healthy it is shown, by the amount of dead cane found, that the yield of cane would not have been less than 32 tons per acre, and the profit would then have been some £10 per acre. The plant crop gave 49 tons per acre.

"Owing to the disease which overtook this variety, all the Rose Bamboo ratoons have been ploughed out, and the ground thoroughly exposed to the air, the roots, leaves, &c., being burnt off or totally removed.

"It is to be remarked that the Rose Bamboo variety throughout the Experiment Station was subject to the same disease of rotteness already described. Plant cane only ten months old showed the disease in strong force, and a very large proportion of the cane was dead before the time of cutting.

"The behaviour of the Rose Bamboo raises the question of cane diseases in a most acute form, and especial effort will be made to unfold the nature of these diseases by exhaustive pathological, entomological, and chemical examinations, which it is proposed to have carried out at the Mackay Station.

"The Director proposes to re-introduce the Rose Bamboo variety from the Sandwich Islands. At the time that the leading variety of cane of those islands was giving out, the Rose Bamboo was imported from Queensland, when it actually saved the situation for Hawaii upon large areas of land. The re-introduction will show what the effect of the change of climate has been. It is clear that a variety which has rendered such great service to the industry in Queensland should not be given up without every effort being made to enable it to regain its original qualities and productiveness."

The report next gives a brief history of the treatment and selection of canes from 1900 to 1904. We have not space to devote to any of the numerous tables of analysis given, but the survival of the fittest is shown in ten varieties which answered so well in 1904, that they have been selected for further trial during 1905.

The results they gave last season were as follows:—

ANALYSES AND CROP RESULTS OF THE TEN VARIETIES SELECTED FOR FURTHER EXPERIMENTS IN 1905.

Serial No.	Country.	No. or Name of Variety.	Density of Juice (Brix).	Sucrose in Juice.	Glucose in Juice.	Purity of Juice.	Yield of Cane per acre in English tons.	Yield of Sugar per acre in English tons.
19	Louisiana .	Louisiana Tiboo Merd*	16·2	14·83	0·71	91·5	45·8	6·1
22	Trinidad ..	Trinadad S. 60 .. .	18·3	16·96	0·71	92·7	55·7	8·4
32	New Guinea	No. 8A	19·8	17·74	1·20	89·6	58·9	9·7
35	Ditto	No. 15..	20·8	19·71	0·55	94·7	59·8	10·8
40	Ditto	No. 24	20·5	19·60	0·27	95·6	63·5	11·1
41	Ditto	No. 24A	19·8	17·86	1·43	90·2	58·9	9·6
42	Ditto	No. 24B	18·6	16·29	1·42	87·6	60·4	8·9
59	Ditto	No. 64..	19·0	16·95	1·31	89·9	56·7	8·6
64	Mauritius ..	Bois Rouge	22·7	20·69	0·31	91·1	51·3	9·4
68	Ditto	Settlers	21·7	20·88	0·34	96·2	52·3	9·8

This final series of tests will cover three years, and include plant and first and second ratoon crops.

On reviewing the tables of results, it is noteworthy and of moment to realise how far the newly introduced varieties have exceeded the older Queensland varieties in agricultural and commercial results. Certain varieties are not yet free from disease. These are being carefully watched, and the utmost care is being taken in order that no cane leaves the station without a clean bill of health.

* Louisiana Tiboo Merd is not at present as high in position as some excluded varieties. There were circumstances during the recent trials which operated against the variety, and this consideration, with the further one that it is the representative of another country, causes it to be included in the "final tests."

The new work in cane experimentation will include:—

(*a*) Continued experiments with canes of the highest promise.

(*b*) The planting of areas of the best varieties for distribution amongst farmers.

(*c*) Experiments in methods of planting and cultivation.

These will include tests in distances between the rows and quantity of seed used, also experiments in different methods of cultivation, with the cost and results.

HISTORY OF THE OCCURRENCE OF THE SUGAR-CANE LEAF-HOPPER IN HAWAII.

[*Perkinsiella saccharicida* (*Kirkaldy*).]

By R. C. L. Perkins.

The Report for 1904 of the Sugar Experiment Station of the Hawaiian Sugar Planters' Association contains as an appendix a long account of the *Leaf Hopper* pest and the best methods so far discovered of getting rid of it. We venture to reproduce a portion of this paper believing it will prove of permanent value to many of our readers.

Mr. Perkins, the Superintendent of the Entomological Division, says:—

In the latter half of the year 1900 I first observed and collected specimens of the leaf-hopper of the cane, but it was not until the end of 1901 or the early part of 1902, that it came under my notice as doing quite serious damage locally on Oahu, and still some months later when its ravages were reported as being more extensive and it was submitted from one of the other islands—namely, Kauai.

In my report written on November 15th, 1902, I remarked: "This small insect is highly injurious to cane and its destructiveness threatens to exceed that of the cane-borer"—a statement, as the sequel proves, by no means exaggerated.

As for various reasons it was not possible for me at that time personally to visit the Windward Islands, during Mr. Koebele's absence from the Territory, I strongly advised that precautions should be taken to keep the pest from being carried thither in seed of other cane on the supposition, or rather in the hope, that it had not already become established there.

Not long afterwards, however, I learnt that it was already strongly established both on Maui and the northern parts of Hawaii, and that any precautions against its introduction were therefore unnecessary.

From that time to the present, samples of cane attacked by the leaf-hopper have been brought to me for examination constantly from all the sugar-growing islands and most districts of these islands, as well as many insects or other creatures supposed (rightly or wrongly) to be attacking these.

Judging from observations made by me on other imported insects, to the rate of increase of which I have paid special attention, I should consider that the leaf-hopper was introduced two or three years prior to 1900; but that until 1900 it was not in such numbers that it would be likely to come under the observation even of an entomologist, except by the merest chance. It is true that some plantation managers think the leaf-hopper has been present on their plantations for many years, but this is certainly an error of identification. During six years' continuous collecting, from 1892 to 1897, when I formed a large collection of leaf-hoppers of many species and from every island, I never met with a single individual of the present pest.

It is incredible that a species which is always gregarious, which produces on the cane the most obvious and characteristic outward signs of its presence, and which when mature is readily attracted to the lights, should have entirely escaped my notice. Then, again, it was one of the first species noticed and collected by me on my return to active field work in 1900. In the early days of my collecting here an allied species of leaf-hopper was known to me to frequent the cane-fields in small numbers, and this would certainly not have been distinguished from the present pest except by a more careful comparison than a non-entomologist would be likely to make. To sum up, it can be stated most positively that the present leaf-hopper attack is due to a pest comparatively recently introduced into the islands and not to one of old standing, which has suddenly become injurious, as some are inclined to think.

The Hawaiian Leaf-hopper, an Australian Species and not identical with any of the hitherto reported Sugar Pests in other Countries.—Seeing then that our leaf-hopper was an imported species, in a report to the Hawaiian Sugar Planters' Association, written on November 15th, 1902, I stated that it was of the utmost importance for us to learn whether our leaf-hopper were one of those already known to attack cane in other countries or some species hitherto unknown as a pest, and in the latter event whence it had been imported. Obviously, if the species proved to be West Indian we did not want to send to Java to look for natural enemies.

Such literature as was to be procured in the islands dealing with leaf-hoppers injurious to cane I examined with great care, and in a report written to Mr. Tenney, of the Planters' Association, on October 23rd, 1902, I expressed my opinion that the Hawaiian pest was "certainly none of these," and reiterated this in my report of November 15th above mentioned. At the same time I called attention to the similarity in habits between the pest here and the Javanese species (*Dicranotropis vastatrix*). Finally, after much correspondence with other countries, the matter was conclusively settled for me by Mr. Kirkaldy, who obtained from Germany cotypes of the Javanese insect described by Breddin and found it to be quite

distinct from the Hawaiian one. Other authorities considered the Javanese insect and ours identical.

Meanwhile I was also corresponding with Australian entomologists in the hope of procuring specimens of a Queensland cane-infesting leaf-hopper for comparison with ours; but it was not till some six months after I began this correspondence that I had the great satisfaction of receiving from Mr. James Clark, of Cairns, four specimens of this Queensland species, which proved to be the same species as our own. Mr. Clark also informed me that this leaf-hopper had been known there for years, that it was their only species, that it did no noticeable damage, and was probably kept in check by some efficient natural enemy.

As I have mentioned in former reports the fact that the leaf-hopper was present on cane in Queensland was discovered by me when inspecting some seed-cane imported from that country, the said seed-cane containing numerous eggs of a leaf-hopper, while a few very young insects were also present. These not being at a stage of development when their identity with our own species could be decided, it was only on receipt of Mr. Clark's specimens that this was finally settled.

General Account of Habits of the Leaf-hopper.—It is not necessary to describe at great length the habits of the leaf-hopper, since they must now be familiar to most of those concerned, and at one time or another I have already fully reported upon these. The following summary may, however, be given. The eggs are laid in a chamber formed by the ovipositor of the female in the tissues of the leaf or in the stem of the cane. The number of eggs contained in one of these chambers varies considerably. Lately in Hamakua district I carefully opened up some hundreds of these chambers and found the number of eggs in each to be from one to twelve in number. That end of the egg which is nearest the external surface is the head end of the future leaf-hopper, and the red pigment spots, which form the eyes of the newly-emerged insect, are conspicuous at some distance behind the narrow apical extremity of the egg before it hatches. In the leaves the eggs are deposited on either surface of the thicker parts and being of elongate form, they usually reach about half way through the tissues. The scar is always visible and is often covered with a little whitish excretion. The apex or head end of the eggs is generally just about level with the surface of the leaf, but sometimes they even protrude a little from the orifice of the chamber. The young emerge perpendicularly, head first, sometimes two together from the chamber, and as they emerge, the appendages at first apparently stuck to the body become free, and the little insect is at once active, and may be seen to perform peculiar sidling or retrograde movements similar to those of older ones or of the adult. As a number of individuals generally hatch from a single chamber, and as

the chambers are extremely numerous in a single leaf, very many being sometimes present in a square inch of surface, and as also in stripped cane thousands of these chambers may be present in a single stick, the total number of leaf-hoppers that can, and sometimes do, emerge from a single stick and its crown of leaves is almost incredible.

The young when they hatch are of a sociable nature and gregarious and especially congregate at the base of the leaves, and this habit is also largely retained by the adults, which also form large flocks in the seclusion of the youngest leaves of the crown.

It is in the immature stages while growth is proceeding that the chief damage to the cane is done and the great excretion of honey-dew takes place.

It is not necessary to trace in detail the development of the insect through its post-embryonic stages to the adult, since in this point it essentially agrees with the several other island Delphacids, in which I have studied these points, and presents no abnormal features.

The development of the tegmima and wings proceeds in the usual manner, by the outgrowth of lobes of the meso- and metathorax. The fully-winged insect is capable of at least moderately extensive flights, as is shown by the fact that it is attracted by the lights of steamers at some distance from the land, and on land to lights very far removed from its proper haunts. It is essentially nocturnal in its activities and when disturbed in the daytime flies but a short distance. or is even unwilling to fly at all, trusting to its leaping powers to escape, or is content to sidle round round the leaf or stem out of sight, or to run backwards when threatened from the front.

The male, except for its rather smaller bulk, its darker abdomen, and different sexual structures, is extremely like the female. Copulation takes place at night. The adult hoppers, most of which lie still or hidden by day, emerge in crowds from their concealment at or shortly before dark. The female not rarely lays eggs by day, but probably much more often by night. When laying, the ovipositor is held at right angles to the ventral surface, and its point of attachment just behind the posterior legs is very clearly seen when the tip is inserted into the tissues of the leaf.

Brachypterious or flightless Form of the adult Leaf-hopper.—At certain seasons of the year, in certain localities at least, and perhaps in all, a distinct form of the leaf-hopper appears, differing very greatly from the ordinary adult. This form is remarkable for the fact that the wings are so little developed as to be unfit for flight and the characteristic markings of the fully-winged individuals are lost. In fact, no one at first sight would suppose the short and long winged forms to belong to the same species, the tegmina, or upper wings, of the former not extending so far back as the tip of the body, while the lower pair are aborted into scarcely visible lobes.

Polymorphism in the development of the wings affecting also often other parts of the body is a well-known feature of the Delphacid leaf-hoppers, and may be seen in other Hawaiian species. This appearance of a single species under two or more apparently totally distinct forms adds greatly to the difficulty of the student in determining the identity of these leaf-hoppers.

One point in connection with this flightless form is worthy of notice. Although the insect has not been with us for study for a sufficiently long time for us to speak with certainty on the point, yet, so far, the worst attacks of leaf-hopper have always followed or been partly coincident with the production of these flightless females, that is to say, during the colder months of the year, or in the early summer. In the course of my recent tour of investigation through Hamakua to Olaa, I did not find a single example of the short-winged form, while in the winter months from some plantations not less than fifty per cent. of the adults sent were of this form. This fact and some observations that I have made on other Hawaiian species, lead me to believe that the flightless leaf-hoppers are more prolific than the fully-winged specimens.

Migratory Swarms of the Leaf-hopper.—As has been already stated the leaf-hopper of the cane is nocturnal in its habits, and these insects are not seen on the wing by day except casually or when disturbed. On certain occasions, however, they have been seen flying in one direction in the daytime in such numbers as to form a migratory swarm quite like that which occurs in the case of certain locusts, dragon-flies, butterflies and other insects. I am not aware that such migrations have been recorded previously of leaf-hoppers, but they are known to be undertaken by the somewhat allied group of Aphidae. It would appear from observations made, that these leaf-hopper migrations are largely due to the fact that the food supply in the place whence they originate has become exhausted or impoverished by the number of the insects.

Signs of Leaf-hopper Attack and its Results.—When leaf-hoppers are present in large numbers the midrib and sheath of the leaf often become conspicuously red, either in spots or almost wholly, but such an appearance may be due to other causes. The minute discoloured scars marking the opening of the egg chambers are a certain sign of the presence of the insects, even though they may not themselves be noticed. I detected the presence of the pest by these scars (on samples of cane sent for examination for other reasons) on certain plantations where at the time the leaf-hopper was said not to exist at all. Like other insects of their sub-order, leaf-hoppers excrete large quantities of a clear, sweet, liquid, called honeydew, and on this the usual fungi grow. Consequently in bad attacks whole fields of cane may be black with the usual black fungus, or in striking contrast white with another species, or the black smut may be followed and overgrown with the

white fungus. Either of these fungi, however, may follow bad attacks of other insects that excrete honeydew, while on the contrary, bad attacks of leaf-hopper are not always followed by a very large fungus growth, for apparently much depends on climatic conditions. Very heavy rains sometimes so entirely wash off the honeydew that no medium for fungi growth remains. These fungi necessarily add to the damage done by the leaf-hoppers. Though they send no * *Hyphae* into the tissues of the leaf, yet they sometimes entirely cover these, and the white fungus may be stripped off from either surface in flakes of considerable thickness, forming a solid shield against light and air.

The result of the leaf-hopper attack when very severe is seen in the drying up of the leaves (from the constant sucking of their juices) before their full functions are performed. In consequence of this the joints of the stem, even at the time when they should be thickening, become on the contrary tapering and contracted, so much so sometimes that the crown topples over and is even entirely destroyed, further growth, of course, being at an end. Young cane is sometimes entirely killed out before any considerable length of stem has been produced.

Although total destruction of a plant only occurs when the leaf-hopper is in the most excessive numbers, yet even when present in large numbers the injury done must be considerable. Should a a plantation, thus attacked, after all produce a crop that comes up to the estimates, yet it is safe to say that without the pest these would be largely exceeded.

Relative Immunity of different Varieties of Cane from Attack.—Some varieties of cane, other things being equal, appear less subject to attack than others. It must not be for a minute supposed that were a plantation formed entirely of one of these more immune varieties it would necessarily escape with little or no damage. The mere fact that the leaf-hopper will attack graminaceous plants other than cane (in the absence of the latter) is sufficient proof that such is not likely to be the case, for there are naturally much greater differences between these and cane than between the most different varieties of the cane itself. Relative immunity from attack is a most difficult matter to judge of, because one can never be sure how much immunity is due to the nature of the variety of cane and how much to other causes. Even in a field of cane of one variety and apparently similar in growth, one can frequently see the capriciousness of the leaf-hopper in its attacks (a capriciousness notorious too in other insects) from the fact that certain spots are more badly attacked than

* Of course reference is here made only to the fungi which usually follow the attacks of Homoptera. Several species of true leaf parasites are found in the cane fields and appear now to be more than usually dis-seminated, possibly owing to the abundance of leaf-hoppers and insects accompanying them, that carry the spores. These fungi so far as I have examined them appear all to be known in other countries and are probably importations into Hawaii.

others. In some cases this is no doubt due to causes that can be perceived by man, such as greater shelter from prevalent winds, a ranker growth of leaf, presumably affording more abundant juice for food, but in other cases no adequate cause for this capriciousness is apparent.

It seems certain that some varieties of cane will stand the attack of leaf-hopper better than others. Mr. Eckart, Director of the Hawaiian Sugar Planters' Experiment Station, has furnished me with a list of new varieties of cane, grown there, arranged in order, according to the relative injury that each sustained from leaf-hopper.

There may come, however, so severe an attack that no cane can resist it. Thus we have seen plants of "Yellow Caledonia" (at the extreme end of the list) which were of the strongest and most thrifty nature previous to the attack, some entirely destroyed and others very badly injured after a bad outbreak. It is, however, probable that from an attack of hopper which would entirely destroy a field of "Rose Bamboo," for instance, a field of "Yellow Caledonia" might recover.

Mode of Occupation of New Fields in a District well occupied by Leaf-hoppers.—When a field of cane is first occupied by leaf-hoppers they sometimes appear to spread over this in a very uniform manner, provided always that the conditions of growth of the cane, shelter, &c., are uniform. This can sometimes be very well seen in fields of very young cane. One that was examined by me consisted of cane about one month above ground, and on the average each plant was the home of two mature leaf-hoppers. Obviously these had migrated thither from adjoining fields, as they could not have reached maturity on such young plants.

Two fields of cane adjoining one another, one of Yellow Caledonia the other of Rose Bamboo variety, each about five months old, held a stock of 20-50 adult hoppers to each crown, uniformly distributed in either field. These also had come by migration, for at the time there were very few young in these fields, and the egg chambers nearly all contained unhatched eggs. This uniform distribution of hoppers over new fields of course only applies to such districts as have already in some parts, at least, a superabundant supply of the pest. Their first appearance in a district has (so far as such early and exact evidence as I have on the subject goes) generally been limited to a quite small area of one plantation.

On Stripping Cane in Leaf-hopper Attack.—As I have incidentally mentioned, leaf-hoppers like the more sheltered spots and hence it can sometimes be seen that they are in less numbers in well-stripped fields than those that are not stripped. This probably means nothing more than that the total number of the insects present are more unevenly distributed than would be the case were all fields stripped.

Probably not many of the pest are destroyed by stripping, since most of the eggs laid in such leaves as are stripped are already hatched, and those which have not will produce young after the leaves are removed as I have myself proved.

Fields of unstripped cane, that already contain leaf-hopper in such numbers as to be doing considerable damage, are better left in that condition, because a large proportion (in fact most) of the eggs and pupæ of some of the most active of its enemies are to be found attached to the old dead or half-dry leaves, and some of these enemies are more intolerant of exposure by stripping than are the leaf-hoppers themselves.

Difference in Severity of Leaf-hopper Attack on Neighbouring Plantations.—In some cases it is evident that neighbouring plantations have suffered from the attack of leaf-hopper in a very different degree. This is due to several causes and sometimes obviously (1) to the difference in the length of time that the leaf-hopper has been present in large numbers. Thus a limited area in a district becomes first badly infected and when this spot has produced a superabundant supply of the pest, it spreads (sometimes in a migratory swarm) over a much larger adjoining area, which suffers greatly, while the cane immediately adjoining this larger area is not much injured. (2) Slightly different climatic causes probably exert a restraining influence or the reverse. (3) In some cases the number of natural enemies of the leaf-hopper (especially the numbers present when first it has occupied a new locality) may turn what threatens to be a bad attack into a light attack. In some cases the fact that on adjoining plantations the seriousness of the attack differs greatly seems inexplicable, and due only to that apparent capriciousness of the insect, of which I have already spoken.

Some eight months ago I wrote in my report, "There is little doubt that its destructiveness will vary much with the locality and according to the season and it is by no means certain that is has as yet, even on Oahu, multiplied to the fullest extent." Later observations have fully convinced me of the truth of these statements, and I would add that were the pest allowed to multiply unchecked by natural enemies, it is by no means necessarily the plantations which hitherto have suffered most that would do so in other seasons, nor those which have escaped considerable damage this year that would be exempt another year.

Mr. Perkins next refers at length to the natural enemies of the Leaf Hopper already present in Hawaii. These include:—

The Black Spotted Red Lady-Bird (*Coccinella repanda*) which takes quite kindly to feeding on the young Leaf Hopper.

The *Cryptolaemus* and *Scymnus* Lady-Birds.

The Lace-Wing Fly (*Chrysopa microphya*). Their larva are not

only able to destroy the young leaf-hoppers but seem capable securing their eggs.

Hymenopterous Parasite of the Leaf Hopper (*Ecthrodelphax fairchildii*).

Various species of Earwigs.

Ants.

Spiders of many species,

Spider Parasites.

Fungi Parasites.

On the other hand there are a large number of insects attracted to the hopper-affected canes and injuriously affecting them. Chief amongst these are the species of *Haptoncus* and two or three species of *Carpophilus*.

Mr. Perkins concludes as follows:—

In the foregoing pages I have dealt with the history of the leaf-hopper since its importation into the islands, its probable native home, its effect on cane and different varieties of cane, its habits, the various other insects that accompany it, whether injurious or otherwise; the impossibility of using insecticides against it, and the possibility of securing effective natural enemies from other countries. More especially have I considered the various natural enemies, animal or vegetable, already present here, and the parasites with which some of these natural enemies are themselves afflicted.

The fine work done by some of the natural enemies now present, added to the fact that as good or better ones can surely be imported from other countries, can leave no doubt whatever in the mind of any entomologist who has investigated the matter, that the leaf-hopper can be so far eliminated by these means as to become as innocuous, as are now a score of what were once some of the worst pests here.

For some of these latter one may now go a long day's march in search without success. So far as the economic entomologist is concerned they are practically non-existent, and the ordinary man has even forgotten that they ever existed.

I further believe that even with the aid of the natural enemies available here on the spot, that by a constant watching for an increase of the pest and by transporting large numbers of the most efficient of its enemies to a spot threatened with a bad outbreak, the damage done by leaf-hopper could be reduced to small proportions. Obviously in the long run it will prove much more economical to send away for additional natural enemies. A few, or it may be even one, species of parasite or predaceous insect successfully introduced would render it unnecessary to pay further attention to the pest.

It is amusing to read the advice given by the leading English-speaking entomologist of a former day, the late Prof. Westwood of Oxford, to the Grenadan planters on a bad outbreak of leaf-hopper occurring in their island.

"I can see," he says, "but little ground for coming to any other conclusion than that man will not be permitted to frustrate the intention of Providence, but that we must look alone with submission to that Power for the removal of these pests."

No doubt the religious feeling which inspired the above remarks is very pleasing to contemplate, but the advice to do nothing is now a little out of date, not to say ridiculous, in the light of our present knowledge. It must, however, be remembered that this advice was given three-quarters of a century ago (1833) and economic entomology has advanced somewhat since those days.

PUBLICATIONS RECEIVED.

Regulations relating to the Construction and Use of Boilers in the Dutch East Indies. By W. W. Campbell, M.I.M.E., 82, Gordon Street, Glasgow. This is a translation of a manual originally written in Dutch for use in the Dutch East Indies. The publication of an English edition has been undertaken in the hope that the information contained therein may prove profitable to a wider circle of readers; especially to those firms who supply boilers to Java, and from ignorance of the tests subjected to them on their arrival, have had apparent reason for complaint. As the author says in his preface, "while these regulations leave much to be desired, this translation puts the conditions relating to the construction and use of boilers in the Dutch East Indies on a known footing."

Sun Pictures of the Antilles and British Guiana. By Algernon E. Aspinall, West India Committee, 15, Seething Lane, London, E.C. 2s. 6d. net. This large, foolscap volume, with a shrimp and purple-coloured cover gives Mr. Aspinall's latest attempt at popularising the West Indies. It contains 40 full-page illustrations from photos taken by the author on his recent tour among the Islands. These are all excellently reproduced. The subject matter consists mainly in information for tourists. But the whole book is got up as a guide for intending tourists to the West Indies, and it gives one a far better idea of what one may expect to see there than does the tourists' ordinary vade mecum.

Hand Book of the Methods Employed in the Sugar Industry and the Raw Sugar Factories of Java. Part I. By H. A. P. M. Tervoren, Sugar Experiment Station *Kagok* in West Java: Amsterdam, J. H. de Bussy. (In Dutch). This is a large work of over 300 pages; it treats in detail the methods of analysis employed in the raw sugar works. We think we can best describe it by saying that it is an enlarged and extended treatise of the various subjects dealt with in our columns during the last eight years by Mr. H. C. Prinsen Geerligs. To those of our readers who understand Dutch, this volume will prove a most valuable addition to their library.

Correspondence.

"BASKET" SUGAR.

TO THE EDITOR OF "THE INTERNATIONAL SUGAR JOURNAL."

Dear Sir,—The description in the December number of your Journal of the "Miller" process of making "basket" sugar, is a fairly correct description of a process in use in Brazil, introduced by the early settlers some centuries ago, probably along with the sugar cane.

By this process the product, well-known in the Liverpool market as "faroffa," literally flour sugar, is made, and it is frequently quoted in the market reports of Liverpool houses by that name. It is practically "concrete" kept in motion to prevent it settling, and is usually made here in the iron pans of the Jamaica train and "beaten," as it is called, with wooden paddles in wooden troughs till it dries. A Fryer's concretor with two or more mechanical stirrers, as used for making a similar kind of refined sugar, may be used on a larger scale for making it.

The colour varies from pale yellow to dark brown, and the polarisation of a few samples I can find noted in my laboratory books varies from 73% to 85½% sugar.

Many of our common process estates, or "engenhos"—there are about 1500 still left in Pernambuco alone—prefer making "faroffa" on account of the high yield, and the price is comparatively good, as it is much used for mixing with other qualities. Most of it is going to South Brazil at present.

I can send you a few samples if you wish.

I am, yours faithfully,

ALFRED J. WATTS.

Pernambuco, January 22nd, 1905.

P.S.—It may interest you to know that a Sugar Conference to which all interested are invited will assemble in Pernambuco on the 12th March. One of the principal points for discussion is the advisability or not of Brazil entering the Brussels Convention.

The Standard newspaper has sent out a special Commissioner to the West Indies to investigate the present condition of affairs in those Colonies. His report will be awaited with interest.

MONTHLY LIST OF PATENTS.

Communicated by Mr. W. P. Thompson, C.E., F.C.S., M.I.M.E., Chartered Patent Agent, 6, Lord Street, Liverpool; and 322, High Holborn, London.

ENGLISH.—APPLICATIONS.

1509. B. E. R. Newlands, London. *Improvements in the preparation of a colouring matter for, and its application in, the manufacture of sugar.* 25th January, 1905.

1629. J. W. Macfarlane, Glasgow. *Improvements in connection with centrifugal machines for sugar.* 27th January, 1905.

ABRIDGMENT.

4112. E. Shaw, London. *Improvements in the treatment or preparation of sugar, and in machinery or apparatus for use therein.* 18th February, 1904. This invention relates more particularly to the class of sugar which is known in Portugal as "assucar areado" (ærated sugar), in Brazil as "assucar refinado" (refined sugar), and in the East as "basket sugar" and which possesses the characteristic properties of very ready solubility, lightness, a marked tendency, when heaped up, to fall away until its appearance resembles that of loose snow, and when rubbed between the fingers feels smooth, whilst when it has been pressed and rubbed with a smooth material such as note paper presents a uniform surface.

GERMAN.—ABRIDGMENTS.

156392. Josef Hyros and Alois Rak, of Brod, Bohemia. *A diffusion battery with constant progression of the material treated, more particularly beetroot shreddings, under water pressure.* 28th January, 1902. This improved diffusion battery, in which there is a continuous progression of the material treated, more particularly beetroot shreddings, under water pressure, is characterised by a constriction or zone for excluding the shreddings formed in each diffusion vessel behind the straining zone, which constriction necessitates the drawing off of the juice through the sieve of the previous zone. A battery formed in accordance with this invention is characterised by the arrangement of a conveyer scoop in combination with a stopping scoop in the transferring chambers, which serve for conveying the material from one diffuser into the next in continuous working. The diffusion battery consists of a number of adjacent diffusers which taper towards their ends, The shreddings are conveyed into the first diffuser and passed through it by means of a conveyer worm. They then come into the transfer chamber and are there conveyed by the conveyer scoop and the stopping scoop into the wider part of the second diffuser through which they pass and are then in similar manner conveyed into the third chamber. The water serving for the

extraction passes under pressure into the fourth diffuser, escapes at the separation zone from the fourth diffuser, and passes at the wider end into the third diffuser and so-forth. It is drawn from the separation zone by means of a pump, flows through a feed-heater and then passes into the wider end of the first condenser which it quits towards the narrower end as finished diffusion syrup, and then finally flows to the measuring vessels.

156663. HEINRICH PASSBURG, of Moscow. (Patent of addition to Patent No. 141065 of July 13th, 1901.) *A method of treating refined masse-cuite.* February 26th, 1904. This is an improvement on the method described in the principal Patent No. 141065 for treating refined masse-cuite, and consists in the masse-cuite, which has been cooled approximately to zero, being cased in moulds insulated against the external communication of heat, so that the temperature of the casing medium (air, water or clear) approximates as far as possible to that of the masse-cuite.

156986. A. WOHL, of Charlottenburg, and Dr. ALEXANDER KOLLREPP, of Berlin. *A process for making a pure-tasting edible syrup from residual molasses of the strontia sugar extraction process.* 13th August, 1903. This invention relates to a process for making a pure-tasting edible syrup from the process of extracting sugar by means of strontia, and consists in treating the residual molasses with lead saccharate with or without the use of acids.

156987. A. WOHL, of Charlottenburg, and Dr. ALEXANDER KOLLREPP, of Berlin. (Patent of addition to Patent No. 156986 of 13th August, 1903.) *A process for making a pure-tasting edible syrup from residual molasses of the strontia sugar extraction process.* 14th November, 1903. This process is an improvement on that described in connection with Patent No. 156986 and consists in replacing the lead saccharate employed in the principal Patent by other suitable insoluble basic lead compounds such, for instance, as lead hydroxide or basic lead nitrate.

Copies of all published specifications with their drawings in these lists can be obtained from W. P. Thompson & Co., 6, Lord Street, Liverpool, at One Shilling a copy for English or American Patents, and Two Shillings for German. In ordering please give number and date.

IMPORTS AND EXPORTS OF SUGAR (UNITED KINGDOM)

To end of January, 1904 and 1905.

IMPORTS.

Raw Sugars.	Quantities.		Values.	
	1904. Cwts.	1905. Cwts.	1904. £	1905. £
Germany	564,581	272,939	243,840	196,596
Holland	23,977	46,940	9,360	34,651
Belgium	28,931	134,132	11,188	99,912
France	6,154	1,463	3,201	1,002
Austria-Hungary	180,901	95,050	79,900	69,140
Java	46,219	130,660	23,230	91,263
Philippine Islands	....	....	....	....
Cuba	....	....	....	....
Peru	92,806	209,961	42,020	159,676
Brazil	23,627	17,559	9,209	12,284
Argentine Republic	....	....	....	....
Mauritius	60,516	25,875	22,134	16,161
British East Indies	18,673	8,228	7,944	3,701
Br. W. Indies, Guiana, &c.	75,673	157,577	48,041	133,343
Other Countries	29,336	92,708	14,890	69,849
Total Raw Sugars	1,151,394	1,193,092	514,957	887,578
Refined Sugars.				
Germany	777,426	1,006,068	429,215	855,495
Holland	217,804	160,563	129,562	139,793
Belgium	31,075	40,277	17,323	34,715
France	100,940	43,691	55,449	37,021
Other Countries	64,768	26,959	33,365	23,783
Total Refined Sugars	1,192,013	1,277,558	664,914	1,090,807
Molasses	141,772	119,796	26,277	27,971
Total Imports	2,485,179	2,590,446	1,206,148	2,006,356

EXPORTS.

British Refined Sugars.	Cwts.	Cwts.	£	£
Sweden and Norway	517	2,647	385	2,242
Denmark	9,978	9,152	5,416	7,305
Holland	5,070	6,796	2,581	5,726
Belgium	1,209	444	695	324
Portugal, Azores, &c.	571	1,499	392	1,179
Italy	320	....	157	....
Other Countries	31,700	9,514	20,960	9,191
	49,365	30,052	30,586	25,967
Foreign & Colonial Sugars.				
Refined and Candy	1,563	1,682	1,179	1,634
Unrefined	3,588	3,776	1,946	2,921
Molasses	19	163	8	70
Total Exports	54,535	35,673	33,719	30,592

UNITED STATES.

(Willett & Gray, &c.)

(Tons of 2,240 lbs.)	1905. Tons.		1904. Tons.
Total Receipts, Jan. 1st to Feb. 16th ..	241,452	..	231,572
Receipts of Refined ,, ,, ,, ..	100	..	....
Deliveries ,, ,, ,, ..	241,452	..	221,424
Consumption (4 Ports, Exports deducted) since 1st January	186,250	..	186,475
Importers' Stocks (4 Ports) Feb. 15th ..		..	22,309
Total Stocks, Feb. 22nd.	158,000	..	105,703
Stocks in Cuba, Feb. 22nd	181,000	..	158,000
	1904.		1903.
Total Consumption for twelve months ..	2,727,162	..	2,549,643

CUBA.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1904 AND 1905.

(Tons of 2,240lbs.)	1904. Tons.		1905. Tons.
Exports	131,228	..	149,888
Stocks	115,185	..	108,732
	246,413	..	258,620
Local Consumption (one month)	3,850	..	4,100
	250,263	..	262,720
Stock on 1st January (old crop)	94,835	..	
Receipts at Ports up to January 31st ..	155,428	..	262,720

Havana, 31st January, 1905. J. GUMA.—F. MEJER.

UNITED KINGDOM.

STATEMENT OF IMPORTS, EXPORTS, AND CONSUMPTION FOR ONE MONTH ENDING JANUARY 31ST.

SUGAR.	Imports. 1904. Tons.		Imports. 1904. Tons.		Imports. 1903. Tons.	Exports (Foreign). 1905. Tons.		Exports (Foreign). 1904. Tons.		Exports (Foreign). 1903. Tons.
Refined	63,878	..	59,601	..	70,728	84	..	78	..	83
Raw	59,654	..	57,569	..	52,135	189	..	179	..	158
Molasses	5,990	..	7,088	..	7,444	8	..	1	..	—
Total..........	129,522	..	124,258	..	130,307	281	..	258	..	241

	Home Consumption. 1905. Tons.		1904. Tons.		1903. Tons.
Refined..	62,594	..	63,400	..	64,276
Refined (in Bond) in the United Kingdom	45,395	..	36,837	..	—
Raw	8,977	..	10,987	.	41,459
Molasses	9,106	..	6,118	..	6,292
Molasses, manufactured (in Bond) in U.K.	4,809	..	4,967	..	—
Total	130,881	..	122,309	..	112,027
Less Exports of British Refined....................	1,502	..	2,468	..	1,960
Total Home Consumption of Sugar	129,379	..	119,841	..	110,067

Stocks of Sugar in Europe at uneven dates, Feb. 1st to 22nd, compared with previous Years.

In thousands of tons, to the nearest thousand.

Great Britain.	Germany including Hamburg.	France.	Austria.	Holland and Belgium.	Total 1905.
174	1027	627	550	156	2534

	1904.		1903.		1902.		1901.
Totals	3448	..	3211	..	3369	..	2693

Twelve Months' Consumption of Sugar in Europe for Three Years, ending January 31st, in thousands of tons.

(Licht's Circular.)

Great Britain.	Germany.	France.	Austria.	Holland, Belgium, &c.	Total 1904-5.	Total 1903-4.	Total 1902-3.
1790	1057	675	476	192	4190	3777	3452

Estimated Crop of Beetroot Sugar on the Continent of Europe for the current Campaign, compared with the actual crop of the three previous Campaigns.

(From Licht's Monthly Circular.)

	1904-1905. Tons.	1903-1904. Tons.	1902-1903. Tons.	1901-1902. Tons.
Germany	1,575,000	1,927,681	1,762,461	2,304,923
Austria	893,000	1,167,959	1,057,692	1,301,549
France	625,000	804,308	833,210	1,123,533
Russia	940,000	1,206,907	1,256,311	1,098,983
Belgium	173,000	203,446	224,090	334,960
Holland	135,000	123,551	102,411	203,172
Other Countries .	340,000	441,116	325,082	393,236
	4,681,000	5,874,968	5,561,257	6,760,356

THE

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All Advertisements to be sent *direct*.

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☞ The Editor is not responsible for statements or opinions contained in articles which are signed, or the source of which is named.

NOTES AND COMMENTS.

Parliamentary Debates on the Sugar Convention.

A Parliamentary Debate on the Sugar Convention is getting quite a hardy annual in the United Kingdom. This year there was the additional incentive that the Government was supposed to be in a moribund condition and might be defeated on the vote. So an amendment was carefully prepared by Mr. Kearley, particulars of which will be found on another page; but the subsequent debate served only to strengthen the hands of the supporters of the Convention and it is considered that the Opposition have been effectively silenced for some time to come. Few of the latter were heard to any great effect; they merely repeated the old string of fallacies, and, what were more dangerous, half-truths. Thus Mr. Lloyd-George asserted that the price had gone down half on the Continent, and had almost doubled here. But he omitted to state from what original figures. He also referred to the large increase in the supply of cane sugar in Java and Cuba during the last 20 years of bounties; but did not touch on the fact that the Cartel bounties, which only came into operation the last two or three years of that period, put a different complexion on affairs, and obliged Java sugar to be sold at ruinously low prices. This could not have failed to have adversely affected supplies in the long run. Mr. Lloyd-George talked about 15,000 men and women in the confectionery trade being thrown out of employment, and that

in return "a few hundreds had been added to those employed in the refining industries of Greenock and elsewhere." One can afford to ignore the gibe about "a few hundreds," but there are also some thousands of men employed in the sugar machinery manufactories who will now be hard at work for some years to come supplying new plant for the colonial sugar industry. They have long suffered from slackness of trade.

Net and Average Prices.

Much strong argument, if not vituperation, might be avoided in these debates and controversies on the sugar question if those taking part in it would, when discussing the rise in the price of sugar, state what price they refer to: the average price, the net price for a particular year (which may have been an artifically low one, as was the case in 1902), or the natural price based on the cost of production. At present confusion reigns, and it is doubtless convenient for certain political parties. Thus we find a cartoon by a well-known Liberal political artist, in which, on one side, Mr. Balfour is shown congratulating Sir Alfred Jones that the Sugar Convention has done so much good to the West Indies by raising the price of sugar; on the other side he is shown informing Mr. Bull that the Sugar Convention has had nothing to do with the rise in sugar. The facts are that the Convention *has* raised the price—from an artificial and abnormally low figure to one more nearly in accord with the cost of production. Thus the Convention is evidently responsible for a rise from 6s. in 1902 to 10s., the price last August. But it has had no direct responsibility for the further rise during the winter months. This last rise is due to the drought and to that alone. But that there have been indirect influences on both sides may be admitted. The virtual monopoly of the world's sugar market, which the bounties have long held for the Continental beet producers, has greatly accentuated the crisis. On the other hand it is doubtless true that the increased consumption shown on the Continent has absorbed some of the sugar that would otherwise have been available for the British market: but had last season's crop come up to expectations no such shortage would have arisen.

The Purport of the Convention.

The situation may therefore be summed up as this: the Convention was formed on sound economic principles to overcome and permanently destroy an artificial system of trade which, while accompanied by abnormal fluctuations of price, had for its ultimate goal the securing of a monopoly in production, whereupon prices would be permanently raised to a high figure by the monopolists to the lasting detriment of the consumer. This monopoly

the Convention has succeeded in preventing by substituting a system based on the equitable laws of free supply and demand. But when so many factors are involved—weather, crops, visible supplies, consumption, &c.,—it is inevitable that, if only temporarily, the course of true trade should not run entirely smooth. The adverse factors so far include: a severe drought on the continent, greatly reducing the beet sugar supply for 1904; an unexpectedly large increase in consumption in France, Germany, and Austria (a satisfactory feature from a cosmopolitan point of view); the inability of the British sugar colonies to recover from a long period of stagnation in next to no time—it is a question of years, not months, to restore a semi-ruined agricultural industry; and the refusal of a few countries to join the Sugar Convention, as a consequence of which their production is subject to a countervailing duty* on entering Convention countries. This last factor is made so much of just now, but it is probably only a question of time ere all the recalcitrants (with the possible exception of Russia) will fall into line with the Convention and have the penalty removed. Several States have already done this; and Argentina, the only other important country besides Russia to hold out, will come to terms as soon as she needs an outside market for her production. We have, we think, mentioned the chief temporary drawbacks of the Brussels Convention; and we are sure all right-thinking men will admit they are of but infinitesimal importance compared with the advantages of permanently securing a constant supply of good sugar at a price based on the cost of production, and coming from such widespread sources as to ensure that no adverse weather conditions in one corner of the world shall have a material influence on the total output available for the consumption of any country. And will not men have the patience to wait till this state of affairs can be an accomplished fact—it is only a question of a few years?

Another Cane Disease in Hawaii.

Mr. R. L. C. Perkins, of Hawaii Experiment Station, calls attention to another cane disease, which in many respects resembles that called "Top-rot" by Wakker and Went in their work on cane diseases. He states that the leaves of the crown are in bad cases all killed; the youngest ones become a putrid mass with an intolerable stench; the stems contain little juice and are extremely brittle. As the top dies the lower eyes grow out in the young cane. Old cane does not seem to be affected by this disease. One or more of the so-called "rust" diseases are also often present on the diseased cane. So far, however, no full knowledge has been obtained of the character and identity of this new pest. The Hawaiian sugar industry seems to be under a

* Our own Government, needless to add, substituted "Prohibition," but either implies virtual exclusion.

somewhat unfortunate cloud just now. Disease and insect pests are seriously affecting the crops, and it will require much labour on the part of the savants stationed there to root out these evils.

"The Defecation of Cane Juices—A lost Art."

Under this heading Mr. W. L. Bass discusses the practice of defecation or clarification in a recent number of *The American Sugar Industry and Beet Sugar Gazette*. He lays special stress on the importance of this branch of the process of sugar manufacture; but deems that the sugar makers of to-day have forgotten how to defecate. Practical defecation which consists of "liming," "cracking," "subsiding," and "decanting," cannot in Mr. Bass' opinion be carried on satisfactorily in any modern contrivance that is "supplied with a coil or piping as "a heating medium, no matter whether it be called an eliminator, a "clarifier or a defecator." His own practice he cites in support of his contention; he has a sugar factory in San Domingo that turned out 9,000 tons of sugar last year, of which the first sugar had a purity of 97 and the seconds one of 90. In his system no filter presses nor crystallizers were used; no chemist was employed. The defecators were properly equipped and the defecation and liming were carried on by unskilled labourers. Finally, no chemicals other than lime were used. The total amount of sugar obtained was 9·27% on the weight of cane. Mr. Bass further asserts that *there is no sugar in sugar cane*, and that "what actually is the case is that a plant called "sugar cane contains a juice which, if extracted at the right time "and properly treated, when later concentrated will yield crystals of "sugar . . . . the extent to which any given cane juice yields "actual sugar depends *largely* upon how it was defecated or clarified "in the defecators." Mr. Bass has certainly the courage of his opinions, but when he proposes we should dispense with the chemist and revert to *unskilled labourers* once more, very few modern sugar manufacturers will agree with him. It is too patent that what the cane sugar industry wants is more skilled chemists and fewer unskilled labourers.

Molascuit Industry.

There is every indication that the manufacture of molascuit is making very satisfactory progress in British Guiana. The average price paid in England during the latter half of 1904 was £4 per ton. A ton of molascuit requires for its manufacture about 130 gallons of molasses of a density 44 to 46 Bé., as well as the megass meal. The cost of the molascuit is as follows: manufacture, including local freight and lighterage, 4 dol. 50 c. per ton; home freight, royalties, commission, &c., 7 dols. per ton; net profit to manufacturers 7 dols. 70 c. (£1 12s.) per ton, equal to very nearly 6 c. per gallon

for the molasses. By employing special machinery the net cost of manufacture can, however, be reduced from 10s. (the cost by hand labour) to 2s. 6d. per ton. In 1904, 2,779 tons of molascuit valued at £12,800 were exported.

Cuba—Tariff Notes.

The reductions of duty accorded to agricultural machinery (in particular to machinery for the manufacture of sugar and spirits) as far back as 1901, are now no longer in force. This change, while doubtless to the advantage of American manufacturers, will be bound to adversely affect the several British firms who have had large dealings in the past with Cuba. Yet it remains to be seen whether the high qualities of the British product will not prove superior to the obstacle of an import duty in the eyes of many factory owners.

Golden Syrup.

The Board of Trade is reported to have issued a circular proposing to invite the Permanent Sugar Commission to include Golden Syrup under the regulations of the Sugar Convention. If this proposal is carried out, all golden syrup would in future have to be manufactured in bond. As at present made, a rebate can be secured on all of this commodity exported. Some objection is being offered by the small refiners in both Liverpool and Glasgow districts, as they consider the cost of special customs supervision will weigh heavily on them. But neither the big manufacturers nor the general consumer will be affected.

Sugar Beet Culture in Ireland.

It must be admitted that the promoters of a beet sugar industry in the United Kingdom are not meeting with invariable success. Thus the Department of Agriculture in Ireland is stated to have expressed the opinion that Irish farmers could not profitably undertake the growing of a beet crop. Too large an area would be required to support a central factory; and the amount of labour required in the fields would be far in excess of that required for other root crops. So it seems Irish farmers will not easily be induced to abandon the cultivation of turnips or mangels in favour of sugar beets.

The gross profit earned last year by the great Say Refinery, at Paris, is stated to have been £181,000; in 1903 it was £300,000.

The Government of Surinam is planning the establishment of large sugar works in that colony. Particulars can be obtained from Herrn Havelaar, Chef van het Bouwdepartement, Paramaribo.

THE FALLACIES OF WOULD-BE FREE TRADERS.

It is almost incredible that the doctrines of Free Trade should have had, during the last forty years, such misguided high priests. Until two years ago the sugar question was the only opportunity for expounding their views, and the readers of the *Sugar Cane* and the *International Sugar Journal* have had frequent opportunities, during that period, of testing the arguments and facts advanced by those who professed to defend Free Trade, and denounced the idea of hindering the foreign producer from being protected in British markets. That, they said, would be protection to British producers. When that argument failed they declared that the first and only principle of Free Trade was cheapness—cheapness of any kind, natural or artificial.

This still goes on. Persons signing themselves "Free Trader" still write to the papers denouncing the Sugar Convention as a protectionist device, and charging it with having caused the recent drought on the Continent which reduced the crop of beetroot sugar from 5,700,000 tons to 4,680,000 tons.

One such enthusiast has attacked also the reputed authors or originators of the Convention, mentioning especially Mr. Martineau by name. This has drawn from Mr. Martineau a letter which seems to us to put the case for the Convention so clearly that we give the following extracts from it (See *North Devon Journal* of March 23rd, 1905):—

The Fiscal Question.

To the Editor of the *North Devon Journal.*

Sir,—A brief letter of mine in reply to a private correspondent found its way into your columns on the 16th of February. I merely stated, in reply to questions, that I was not connected with the West Indies, but had dealt with the sugar question for many years as Secretary to the British Sugar Refiners' Committee. I added a few remarks in reference to the present controversy about the price of sugar, in which I pointed out that every reasonable person must admit how impossible it is to be supplied *permanently* with an article below cost price, because all the natural producers would shut up shop. That, I said, was just what Germany and Austria hoped for with regard to sugar.

My attention has now been called to a letter in your *Journal* of the 9th inst. in which the writer attacks my simple and self-evident assertions, having failed to read with sufficient care what I said.

* * * * * *

He mis-reads my little axiom. I never said that the bounties had caused the production of cane sugar to cease. I merely stated an evident truth—that the *permanent* supply of an article below cost price must shut up all natural competition. I added, as a corollary,

that if we could be guaranteed the *permanent* supply of commodities below cost price—or for nothing—we should all of us be only too pleased. That is the whole point of the argument. It is because the supply of sugar below cost price is bound to be *temporary* that such an artificial interference with the course of nature is to be deprecated —not only in the interest of the producer, but also, still more, in that of the consumer. An intelligent reader would have read this moral between the lines of my short note.

"Free Trader" desires to dispute this, and I am quite prepared to join issue with him, though I should hesitate to trespass on your valuable space were it not that this question of price has become a somewhat burning one.

The process of bounty-fed competition is an interesting study for a Free Trader; and as I happen to be intimately acquainted with every detail of it I will give your correspondent the benefit of my experience. It is an object lesson as to the effect of allowing foreign producers to be protected in British and other neutral markets, and is, therefore, of great value to Free Traders like your correspondent and myself.

Bounties necessarily cause overproduction, which, in its turn, causes a glut, a fall in price, and (as the late Lord Farrer put it) "collapse and ruin." A fall below cost price brings immediately a reduction of production and a consequent rise. Here are the figures for a few years as regards sugar:—

	Stocks on 1st Sept. Tons.	Highest Price per cwt.	Lowest Price per cwt.
1884	1,000,000	18s. 2d.	9s. 9d.
1888	750,000	16s. 3d.	12s. 6d.
1889	600,000	28s. 3d.	11s. 0d.
1893	600,000	19s. 0d.	12s. 2d.
1897	1,250,000	9s. 4½d.	8s. 2d.

These are sufficient to show the kind of fluctuations brought about by bounties. From 1884 to the present time we have had prices down to 9s., 8s., and even 6s., for an article which costs 9s. 6d. to 10s. to produce. These low prices have been brought about by overproduction, resulting eventually in excessive stocks throughout the world at the end of the season, amounting sometimes to over a million, and recently to over two million tons of sugar. This overproduction has invariably been followed by a reduction in production, which has frequently brought stocks down to a dangerously low level, and has raised prices to 18s., 16s., 28s., 19s., and now to 14s. 6d. This last rise is caused, like some of its predecessors, by bounties having made us dependent on one great and artificially stimulated industry—the European beetroot crop. Whenever it has a bad season we have high prices. That was the case in 1889, when prices went up to 28s., and stocks dropped to 600,000 tons. Again, to take a more recent instance, stocks at the end of the season in 1902 stood

at the enormous figure of 2,000,000 tons, and we had prices down to 6s. That figure was repeated in 1903; and even in 1904, in spite of a great increase in consumption, the world had a stock on the 1st of September of 1,427,000 tons, coupled with very low prices, which would have continued had it not been that the beetroot crop suffered from a great drought, and instead of turning out 5,700,000 tons of sugar, as it would have done under ordinary conditions of weather, only yielded 4,680,000 tons. Hence these tears.

These facts show that a bounty-fed production grows very big and keeps all other production very small, first lowering prices to a point where natural producers cease to progress, and then, when the reaction comes, with reduced stock, driving prices to so a high pitch that competition revives and the process repeats itself. In the end the consumer finds that on the average he has paid more for his sugar than he would have done if there had been no bounties. These figures also show how misguided I should have been if I had, as your correspondent declares, stated that "the sugar cane production of the world was becoming extinct under the influence of the Continental bounty system." What they do show, as I shall presently prove, is that in each swing of the pendulum the natural producer has been checked in his progress, while his bounty-fed competitor has gone on doubling and trebling his production.

The great and original slump in the price of sugar, caused by the bounties, came in 1884. The lowest price ever known for the standard quality of raw beetroot sugar was, at that time, about 19s. The market became so overstocked in 1884 that prices fell to that figure and then quietly continued to fall to half that price, viz., 9s. 9d. There was immediately a violent reduction in production, and prices rose to 17s. The pendulum has repeated the swing ever since. The following figures show the result; beetroot has progressed and cane has nearly stood still.

VISIBLE ANNUAL PRODUCTION OF THE WORLD IN TONS.

Average of five years ending	Cane.	Beet (European.)
1888	2,658,153	2,432,605
1893	2,820,429	3,358,237
1898	3 111,576	4,471,373
1903	3,584,238	5,669,513

In the five years ending		
1873	cane sugar constituted 65·9	per cent. of the total.
1878	,, ,, ,, 58·2	,, ,, ,,
1883	,, ,, ,, 53·3	,, ,, ,,
1888	,, ,, ,, 52·2	,, ,, ,,
1893	,, ,, ,, 45·6	,, ,, ,,
1898	,, ,, ,, 40·9	,, ,, ,,
1903	,, ,, ,, 38·3	,, ,, ,,

I have never used the rise of 400,000 tons in the recent production of cane sugar as an argument. Of course, everybody knew that 6s. would not be a permanent price, and all who were conversant with the subject knew that if it lasted much longer it would practically leave Germany, Austria, and France masters of the situation. "Free Trader" contradicts my statement that Germany hoped for such a result. By "Germany" I meant the German sugar industry, not the Government. The leader of that industry distinctly stated, a few years ago, in a speech at their general meeting, that low prices were what they must aim at in order to crush competition.

I really must apologise for this long letter, but I am anxious, as a free trader, that "Free Trader" should master the rudiments.

I am, sir, yours faithfully,

GEORGE MARTINEAU.

Gomshall, Surrey, March 16th, 1905.

THE SUGAR CONVENTION.

ANOTHER DEBATE IN PARLIAMENT.

As was only to be expected, the Sugar Convention has formed one of the several questions of the day that have served as a pretext for the Opposition to hinder the legitimate Parliamentary business by means of amendments to the Address or movements to adjourn the House. On February 28th and March 1st, the greater part of two days was taken up in discussing the following amendment, moved by Mr. Kearley (Devonport):—

"But we humbly represent to your Majesty that your Majesty's Government in committing the country to the policy of the Brussels Sugar Convention have inflicted heavy losses upon trade, diminished employment of labour, enormously increased the cost of a necessary food to consumers, without any compensatory advantage; and we humbly submit to your Majesty that these evil results call for an immediate remedy; and that the Convention should be denounced at the earliest possible moment."

Mr. Kearley argued that the British refiners had really enjoyed undisturbed prosperity for 45 years, and therefore did not need the aid the Convention was supposed to bring them. He asserted that there was no proof that the rise in the price was due to the drought; the shortage, he estimated, would have accounted for a rise of but 1s. or 2s., and the price had increased by 150 per cent. He attempted to draw unfavourable conclusions as to the effect of the Convention on the West Indian supplies, and concluded by pointing to the growing competition abroad in the confectionery business—the result of the Convention.

Several other members of the Opposition spoke, and then Mr. Chamberlain's turn came. He began by saying it was true he took

a very great interest in the matter; but he refused to admit that he was the author of the Convention so vigorously condemned by the Opposition. He regretted one of the speakers could not separate the question of the sugar tax from that of the Convention. He admitted that he himself did not approve of the sugar tax, but regarded it at the present time as a necessary means of raising revenue. The statement that sugar was cheaper on the Continent than here was not true; there was not a single country in which sugar was cheaper now than in England. The question before the House that night had nothing to do with the West Indies; but as—

It is charged that the Convention has done no good to the West Indies, I venture to tell the hon. gentleman that there is not a single person connected with the West Indies who will agree with his statement—whether he be a Tory, a Liberal Unionist, or a Radical, or an independent person, as the hon. gentleman calls himself—something like Mahomet's coffin, between heaven and the other place. None of these people connected with the West Indies will justify the statement the hon. member has made; and if he wants an illustration I will refer him to the Radical candidate for Buteshire, Mr. Lamont, who is, I believe, connected with the West Indies, and who told his constituents in a speech only the other day that no greater boon has ever been conferred on the West Indies than this Convention.*

Mr. Chamberlain next went on to discuss the facts relating to the rise in price and showed that the weather had affected not only sugar but cotton, potatoes and onions, yet the Government is blamed for it in the case of sugar alone.

Last year, wasn't it, a tremendous rise in the price of cotton took place—a matter of infinitely more importance than the rise in the price of sugar, a matter paralysing the whole of the vast trade of the biggest industry we have, except the industry of agriculture. Was there any kind of party, what you may call political, discussion during the whole course of the dearth of cotton? It was due to the same cause as the rise in the price of sugar. It was due to the diminution of the crop in America, and to the natural consequences of such a diminution, the attempts of monopolists to control the crop. Well, I do not take that alone. I heard some fear of something of the kind now—I am not really informed on the subject—but again and again a failure in the crop of potatoes in Ireland has been infinitely more serious. That has not touched merely the question of a slight rise in price of a necessary of life; it has been a question of the existence of a people. But there, again, has anybody ever charged, has even the most bitter opponent charged the Government with having by artificial means caused a catastrophe which was due to the act of God? Those are big things, but *there has recently been, from the same cause as that affecting the price of sugar*, a drought—there has been an enormous increase of 400% in the price of onions. . . . . . There again, I ask, has anyone read a debate in this House on an increase in the price of onions? I will take another thing in which the rise is less; I will take the rise in the price of corn. It is well known to every

* For this and other verbatim extracts from the speeches we are indebted to *The Times* report.

one that in the last year the price of wheat has risen by 5s. a quarter. Why, good heavens! we are told that the skies will fall if a duty of 2s. is put on it—and here by purely natural causes there is a rise of 5s., and no one lifts a hand or speaks a word in reference to it. I say in all these cases—and I might quote many others—the matter is treated as regrettable, no doubt, but as due to causes which are beyond human control. But now, from causes which I shall show to be the same, there is a rise in the price of sugar, and the Opposition no longer attribute it to these ordinary and natural causes, but to the indescribable malignity of the men who sit there, "the worst Government that the world has ever known," and they say it is due entirely to their infamous and nefarious action.

Further extracts from Mr. Chamberlain's speech, as will be of interest, may be given here.

We are told that this rise—for the moment I leave out of sight to what it is due—has ruined great trades in the country—jam and confectionery—and thrown out of employment numbers of people. It is very difficult to follow the argument. I take jam. Here is a curious fact. At the end of 1904 the wholesale price of jam was lower than it was before the Convention. I do not attempt to explain it. That seems to me to be inconsistent with the argument that the Convention has ruined the jam trade. If after the Convention, and even after the rise, jam manufacturers are able to sell their jam at a lower price than they did long before the Convention came into operation, for the life of me I do not see how the Convention is answerable for the ruin of the jam trade. . . . . . Let us see what could these confectioners have done. Only last May—only a few months ago—they could have bought sugar at 9s. 6d. a cwt., and that price is 11d. lower than in 1900, 6d. lower than in 1899, and in 1899 you had not even heard of the Sugar Convention. They could actually have bought a few months ago lower than the price at the time when the bounties were in full force. They did not do it. It is not for me to criticize the action of private firms; but I think, at all events, the point wants explanation before we accept as true the statement that the jam trade and the confectionery trade have been absolutely ruined because they have had one or two months of excessively high prices. . . . . . I have spoken of fluctuations. In 1887 there was one of them. What did sugar come to then when there was no Convention? It went up from 11s. to 28s. 3d., a rise, therefore, of 17s. 3d. in a single year. The confectioners approached the Government and said that the trade was paralysed, which was perfectly true. One of the greatest of them complained of this violent fluctuation, pointed out its consequences, and asked for a remedy. What was the remedy the confectioners asked for? They asked that the bounties should be abolished.

In conclusion, Mr. Chamberlain showed that though we excluded Russian and Argentine sugar yet it was such a small fraction of our total supply that its influence on prices must needs be very small. Moreover, what sugar has been excluded has been sent elsewhere, and has set free corresponding amounts of German or Austrian sugar.

Mr. W. Lawrence said the Opposition "were endeavouring to bolster up an industry, of very great value no doubt, but which

claimed to have its raw material at less than cost price, and to be free from outside competition. That was a position at once absurd and utenable."

Another member asked if the Government would once again make such a Covention as this, if their hands were now free. Mr. Gerald Balfour (President of the Board of Trade) at once replied that they were *quite ready*.

Sir William Thorburn said that the only argument of the Opposition was one in favour of the principle of bounties.

It was a remarkable evidence of the sincerity of the hon. gentlemen's devotion to free trade. He did not admit that losses had been inflicted on the sugar-using trades. But owing to the enhanced prices of sugar the profits had not been as large as usual. The returns of two confectionery companies recently issued showed dividends in the one case of 12% and in the other case of 10%. He was convinced that the Convention was not responsible for the increase in the price of sugar. It was the drought on the Continent which was responsible. The Convention had stimulated to a great extent the growth of cane sugar, with the result that this year there were 400,000 tons more cane sugar in the country than last year. But for that circumstance the price of sugar to-day would have been £4 or £5 a ton more than it was at the present time.

Mr. Bonar Law (Parliamentary Secretary to the Board of Trade) made a very long and able speech in defence of the Convention. It was essentially the speech of the evening and brought him out as a most skilled debater and one of the most promising men the Government have to look forward to. If this debate did nothing else, it served to securely establish Mr. Bonar Law's reputation. He pointed out that—

It was a familiar argument that what was wrong with the West Indies was antiquated methods and the want of improved machinery. If the right hon. gentleman the member for Aberdeen (Mr. Bryce) referred to the right hon. baronet the member for Berwick (Sir E. Grey), who was a member of the West Indies Commission, he would learn that because of the bounties the manufacturers of beet sugar could afford to have the best machinery, and that by the abolition of the bounties the West Indies, being placed in a position of equality with their rivals, would be able to obtain the most improved machinery also. The hon. member for West Islington had contended that three-fourths of the rise in the price of sugar was due to the shutting out of sugar from our markets. He wondered whether the hon. gentleman realised what that argument came to. The result of that contention was this, that owing to prohibition the Government had made the price of sugar dearer than it would have been had our markets been open to sugar from Russia and Argentina. But the largest market for Russian sugar was the East, where it went in much larger quantities, and where it competed with Austrian and German sugar. Was it not obvious that when Russia was thus selling a large part of her production, all that was necessary to sell any surplus was to take a smaller price than that of the Convention? If the market had been open,

Russian sugar would have been sent here at a lower price than could be obtained in the East. There was another point. Switzerland was one of the countries which were open to receive the Russian sugar; and that reminded him of a rather curious incident. The hon. member for Devenport had made the strongest case hitherto against the Convention, but he was only able to do so by throwing overboard three-fourths of all the speeches and pamphlets which have been delivered on this subject during the recess, in every one of which it was stated that, owing to the prohibition, confectioners in Switzerland were able to get their sugar cheaper, and were so able to beat us in our own markets. The fact was that sugar was dearer in Switzerland than here, and that since the Convention came into force. Moreover, in competing with us, either here or in neutral markets, the Swiss manufacturers were handicapped to the extent of fully 20 per cent. even on the price of raw material, as they had to pay their own duty. Whatever might be said about the Sugar Convention, he did not see how any one could possibly say with truth that it was a step in the direction of protection. In the arguments it had evoked it had illustrated the difference between the theory of free trade and the theory of free imports. To the free importer cheapness was the one thing necessary, whereas to the free trader freedom of exchange was the one thing necessary, and everything else, even cheapness, was unimportant. Cobden said that cheapness was not the basis of his policy, but free exchange and natural price. The right hon. gentleman who had just sat down tried, he thought somewhat disingenuously, to show that Mr Gladstone looked on bounties as bad only for the countries that gave them. He would quote the following passage from a speech of Mr. Gladstone's:— "We do not regard with any satisfaction the system under which local fiscal advantage is given in our markets to the products of foreign labour. Some people say it is a good thing because the consumer gets the benefit of it, but I do not think that any benefit founded on inequality and injustice can bring good even to the consumer." That was their exact case. But he would make a quotation of more recent date. There was a debate on this subject in the House in 1899, and the leader of the Opposition then said, "These bounties appear to me to be bad, because they disturb trade and hinder the development of the country." He did not say that they were bad for the country which gave them. So that even the right hon. gentleman had become a very recent convert to the new theory of what free trade was. The question for consideration was whether the Convention in itself was a good or bad thing. The Convention came into operation in October, 1903. Did the price immediately rise? On the contrary it fell; and six months after the Convention came into operation the price had only risen to that at which it stood the day before the Convention came into operation. If the Convention were the cause of the rise, the rise must have occurred earlier; it could not have taken six months to bring about that change in the price. He was quite ready to admit that there was something in the argument of the hon. member for Devonport about the price not falling after the Convention came into operation. The hon. member's argument was that these Governments had earmarked a large quantity of sugar to receive the bounty and to be shipped after the date the Convention came into operation. That, he admitted, would have an effect on prices;

but he maintained, on the other hand, that it ought not to have had the effect of counteracting the expectation of increased prices owing to the bounty. He had had a large experience in other articles that fluctuated more than sugar. He had seen immediate statistics dead against a rise in price. He had seen stocks increasing month after month, and yet the price steadily rising. Why was that? Because people who knew most about the trade believed that better times were coming in the future and were willing to lie out of their money in expectation of the higher profits they would get when that expectation was realised and the price had decreased. He maintained that exactly the same thing would have happened in regard to sugar if there had been that belief in the Convention raising the price. What was the cause of the rise? There was an unexpected shortage in the beet supply of more than one million tons. Did any one for a moment deny that that shortage in itself was bound to produce a big rise in price? He did not say it might not be possible that the rise had been accentuated by the Convention; but there was no evidence whatever of that. In fact the whole of the evidence was in the contrary direction, for while the crop of beet sugar had decreased the crop of cane sugar had increased to the extent of nearly 400,000 tons. Hon. gentlemen opposite said the Convention had nothing whatever to do with increasing this supply of cane sugar. He did not think they would get any one to believe that. He thought there was not the slightest doubt that the fact that the Convention was signed did encourage the production of cane sugar all over the world, and that as a consequence some part at least of the increase was due to the Convention, and that it counteracted the effect of the shortage in the beet supply. It was said that ruin was falling on the confectioners. His right hon. friend the member for West Birmingham had just pointed out that so recently as May of last year they could have bought sugar for delivery at the end of that year at 9s. a cwt., or only 6d. a cwt. above the price the day before the Convention came into operation, or they could have bought it up to the end of this year at only 6d. advance on that price. Why did not they buy? He thought there could only be one answer to the question. They did not buy because they did not believe that the Convention would have the effect of raising the price, neither did any one else. The people who made their living by buying and selling sugar did not expect it, or they would not have been willing to sell at this lower price, and the fact that they were willing was proof that the rise was not due to something that could have been foreseen, but to something which was absolutely unforeseen—namely, the drought on the Continent. . . . . . . But they knew that the present day high price was temporary and that it could not permanently injure the sugar users in this country. Hon. gentlemen opposite looked at this matter as if our whole interest in it was as consumers—as if it did not matter to us where we got the sugar so long as we got it. That was a very shortsighted policy. What would be the effect of the abolition of the bounties? The prosperity of the West Indies was admitted by every one. It was admitted that money was pouring into the West Indies as it had never poured before. With new machinery and more scientific methods they would be able to produce sugar when bad times came cheaper than they had ever done before.

Mr. Gerald Balfour (President of the Board of Trade) said he was unable to understand the real attitude of the Liberal Party towards the Convention. One member was ready to ask for more bounties, another held that bounties were economically unsound. A third told them that if Cobden and Gladstone had had to deal with the problem they would have been ready enough to enter into an arrangement for abolishing bounties, the only difference being that certain provisions in the Convention, such as the penal clause and the surtax, would have been deleted by them. After discussing the status of the Permanent Commission and its powers of action, Mr. G. Balfour went on to discuss some of the points raised by the Opposition.

He pointed out that in one sense the Convention had had an effect on the price of sugar. The price during a considerable period previous to the passing of the Convention was an unnatural one, such that the sugar industry in many parts of the world could no longer be carried on at a profit. Therefore, if they started from the price of 6/-, of course the natural tendency of the Convention would be to raise it to one more nearly approaching the natural or normal price. In countries which were not parties to the Convention the rise in the price of sugar, according to the view of the hon. member for Islington, should at least be 3s. less than it had been in the United Kingdom. But what was the fact in Switzerland? There the rise in the price of sugar was greater even than it had been in this country. Surely that fact blew the entire case of the hon. member to the winds.

The voting on the amendment resulted in its defeat by a majority of 65, a sufficiently substantial margin to show what was the opinion of the House.

From "The People":—

I attended a public meeting in a village one night this week. It was called by the Conservatives, but there were a great many Radicals present; and at first they asked a lot of questions, but I could not help laughing at a little dialogue that took place between one of the speakers and a farm labourer. "How about the price of sugar?" shouted the labourer. "How about the price of onions?" retorted the speaker. "Wot's that got to do with it?" said the labourer. "There ain't any tax on onions, and there ain't bin no onion convention." "I know there ain't," said the speaker, "and yet onions that were selling last year at five pounds for 2d. now fetch 2½d. a pound. How has that come about?" "Why," said the labourer, "that's 'cause it was a bad time for onions last year." "Quite true," said the speaker, "and now you have answered your own question. It was a bad time for onions last year, and the price has gone up; it was a bad time for sugar beet last year, and the price has gone up—it is caused by a failure in the crop in both cases, and taxes or conventions have had nothing to do with it. Next question, please!"—but there was no next.

MODERN SUGAR MACHINERY.

(*Continued from page 60.*)

I. Centrifugals (continued).

While dealing with electric centrifugals, we may here remark that the credit of first applying an electric motor to the Weston Centrifugal Machine belongs to Mr. Alexander Watt, chemist with Messrs.

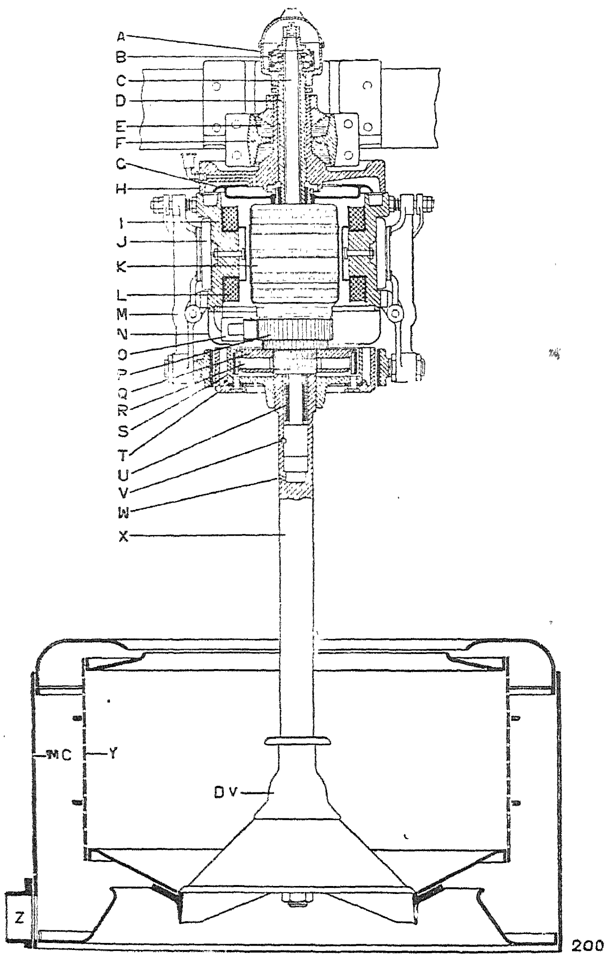


Fig. 1.

Macfie & Sons, Liverpool, who patented such an application in the year 1884, but unfortunately for him he was apparently ahead of his time.

While others applied their energies to perfecting belt or water driving, Messrs. Pott, Cassels & Williamson, of Motherwell, were engaged in solving the problem of electric driving, and to them belongs the credit of being the first to produce and supply a satisfactory electric-driven Weston Centrifugal Machine.

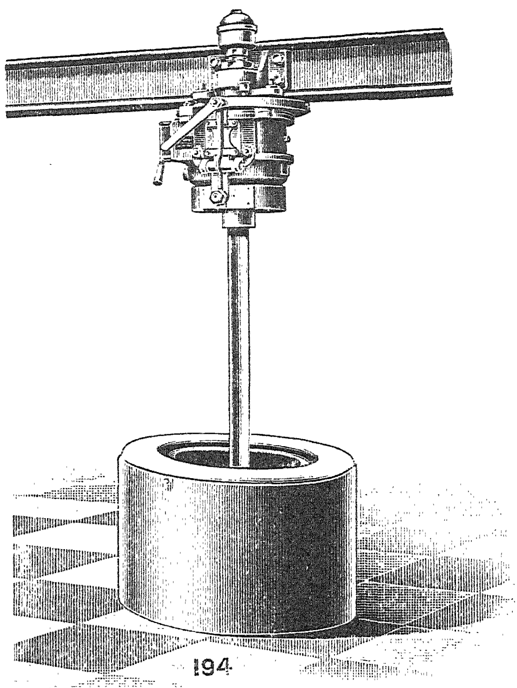


Fig. 2.

We give an illustration of this firm's design, the essential point being that the electric motor is applied directly on to the spindle of the Weston machine and oscillates with it. It therefore differs in these respects from the type illustrated and described in a previous article.

The manner of accomplishing this attachment is as follows:—

The top plate H of the motor (*see Fig. 1*) is attached to the inner

spindle D, so that when the centrifugal machine oscillates the outer part I of the motor swings in unison with the same.

The starting of this machine is also accomplished without resistance coils, by means of Pott, Cassels & Williamson's patent friction clutch R.

The armature K is free to revolve on the outer spindle X, and fixed to the lower end of the armature is the driving disc Q, containing friction arms R. On the outer revolving spindle X is fixed the driving pulley S.

When the current is switched on, the armature K, being loose on the outer spindle X, at once attains a high speed, thereby preventing damage to the coils, and communicating motion gradually to the spindle X, of the machine through the pulley S; by means of the friction arms R, which act under the centrifugal force generated by the speed of the armature.

A simple switch, therefore, is all that is necessary to start or stop the machine. Advantage is taken of the magnetism due to the field coils to operate the brake. When the current is switched on, the magnet pieces J are attracted towards the outer case I of the motor, which releases the brake M from the brake pulley T; when the current is switched off the brake is automatically applied by the springs, which are shown at the top of the brake.

It will be seen that the motor is completely protected, and as it occupies the same position as the top pulley on the belt driven machine, it is out of the way; at the same time this machine occupies less height than machines having the motor above the supporting beams. *(See Fig. 2.)*

The whole weight of the revolving part of the machine is carried by this firm's well-known Patent ball bearing B, which dispenses with the use of flat washers inside the spindle, that often gave trouble by "firing up," and were difficult of access for repairs.

The machine is hung on an elastic bearing E, carried by a suspending bracket F which is supported from an overhead beam.

The patent friction drive permits of the use of a series wound motor, which gives a large starting torque, and in connection with this we may mention that as the load of a centrifugal machine is constant whether the basket is charged or empty, a series wound motor is admirably adapted for the work.

We may also mention an important attachment which this firm have recently patented, and which permits a large current to flow through the armature at starting, automatically cutting itself out, when the machine has attained full speed. This apparatus is termed an "Accelerator" because by its aid the machine can be very rapidly "lifted" to full speed, and it is also easily regulated for starting more slowly when desired.

Messrs. Pott, Cassels & Williamson also manufacture centrifugals with overhead fixed motors, and their machines are constructed for either alternating or continuous current.

Turning to the leading American practice, we find it, as exemplified in the S. S. Hepworth Co.'s machine, differing widely in some respects from the British types already described.

In the Hepworth Electrical Centrifugal the motor is mounted clear above the frame, and can be lifted off the spindle by removing a single nut at the top. It is compound wound, in a manner to give a variable speed of sufficient range for all classes of sugar. The makers hold decided views as to the necessity of a rheostat for starting.

They claim that the rheostat is not only a necessary adjunct to a variable speed motor, but is absolutely indispensable for getting the machine into motion quickly. They do not see their way to employ any device which allows the full current to be applied at the very beginning, believing that this results in a constantly diminishing turning effect as the motor gains speed and, as a consequence, a slower acceleration.

They therefore fit a rheostat with controller, automatic circuit breaker, and armature and field resistance.

The Hepworth machine being self-balancing, the rotating parts are permitted to swing, in the usual way, about the centre of a ball and socket joint which forms their support. They can do this, however, only by carrying with them the non-rotating parts of the motor. These oppose motion sufficiently to prevent excessive swaying.

II. Cane Mills.

In the construction of cane crushing mills, no special patents now hold the field; the leading makers aim rather at securing a perfection in finish and detail as shall ensure the maximum of efficiency in working and the greatest accessibility and convenience for repairs and renewals. We, therefore, do not find any very great variations in individual practice. Much has been heard, of late, of the nine-roller and even twelve-roller American mills; but practice has not yet by any means conclusively shown that they are much if at all superior to three or four sets of three-roller mills. These types can be obtained from British makers with the advantage that such mills would have the greater strength and rigidity which has so long been and is still a feature of British made mills when compared with American.

Fig. 3 is a large modern sugar-cane crushing mill as supplied to Cuba by The Mirrlees Watson Co., Glasgow.

The mill has rolls 36 in. dia. × 78 in. long of a very special mixture of iron and steel, which has been found to combine the requirements of strength and the retention of a coarse surface, and not given to wearing unduly. The rolls are heated, forced by hydraulic pressure upon their steel gudgeons, and further secured by

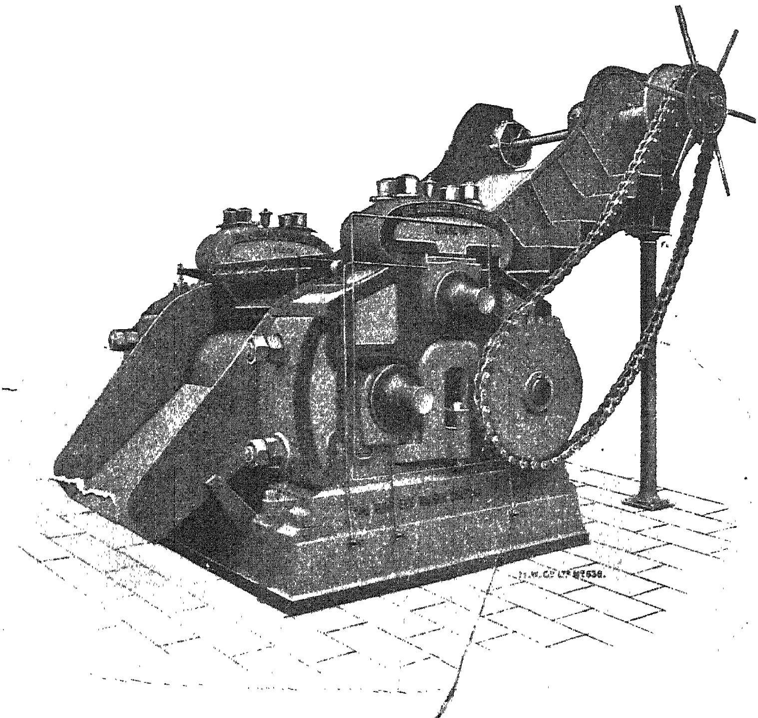


FIG. 3.

means of keys at each end; these again being prevented from working back by means of split hoops with a covering ring shrunk over them.

The mill cheeks are of a specially heavy design with the top caps held down by means of four "high tensile steel" bolts, kept as small as possible in diameter in order that the two side rolls may be brought together as close as possible so that the width of the trash turner may be reduced to a minimum. The side caps are held up to their work by means of two steel bolts passing through from one side to the other of the headstock, both the top and side caps being arranged with carefully fitted surfaces gripping the headstocks so as to act both as ties and struts.

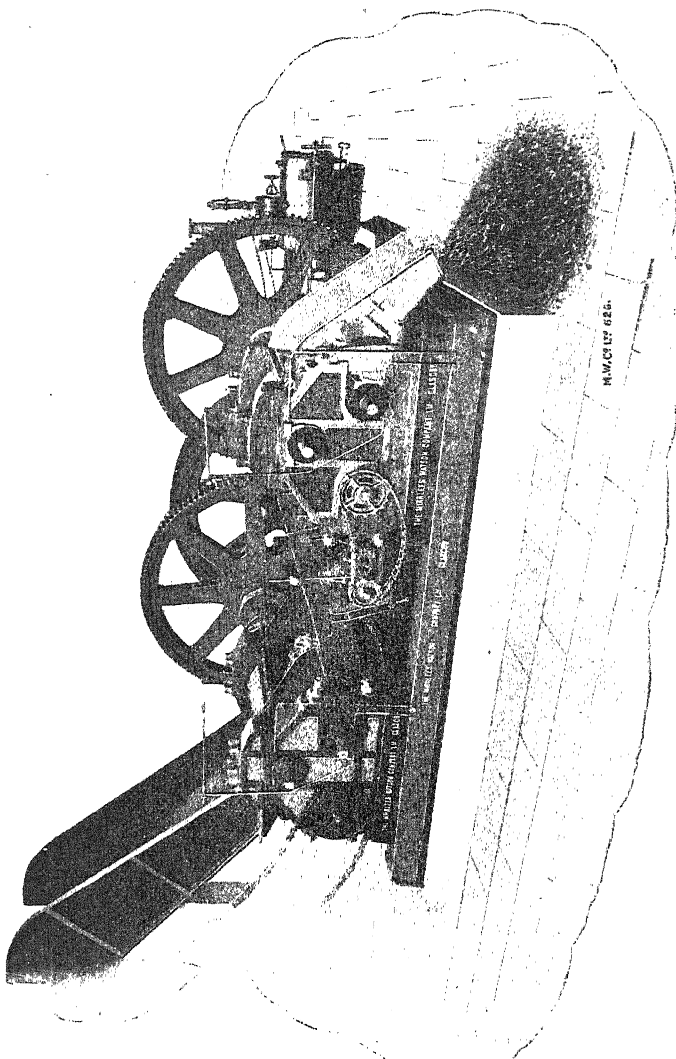


FIG. 4. CANE MILL FOR ANTIGUA CENTRAL FACTORY.

The adjustment of the side rolls is made by means of wedges, which can be seen in the illustration between the back of the side roller brasses and the side caps; these can be raised or lowered by means of the bolts which can be seen projecting through the top of the headstock.

In order to keep the brasses cool they are made hollow for water circulation, the connecting pipes for same being shown very clearly in the illustration.

The top roll has a strong steel scraper which is held up to its work by means of levers and screws which can readily be seen, and the back roll is also scraped by the bottom plate of the megass chute; the regulating screws are not seen in the illustration. In addition, this bottom plate is also arranged to hinge upwards to permit of the mill bed being readily cleaned out.

There is in connection with the gearing a very massive second motion spur wheel with steel segments, and loose arms cottered to the boss; this enables the various parts to be reduced to convenient dimensions for transport.

In many cases the mills are fitted with the now well-known *Toggle* pressure regulating apparatus on the top roll. There has been from time to time considerable discussion and differences of opinion regarding the merits of this apparatus. During its 15 years of constant use in many countries, a considerable amount of study has been given to its details, and it has been adopted on all of the most recent installations of heavy grinding plants for Fiji, Argentina, Mexico and Natal, as well as many other countries.

In the preceding illustration (*Fig. 4*) is shown the arrangement of two three-roller mills recently supplied to the Antigua Central Factory by The Mirrlees Watson Co.

Each of the mills is fitted with rollers 30 in. dia. × 60 in. long having steel gudgeons; journals all 14 in. dia. × 16 in. long.

These are driven by one horizontal engine having a steam cylinder 26 in. dia. × 48 in. stroke running at 55 r.p.m. fitted with link motion, reversing gear, piston slide valve, heavy flywheel, and strong first motion pinion of steel.

Heavy spur gearing of steel, resting on one bedplate for driving both mills from the above engine, is fitted; the surface speed of first mill is $21\frac{3}{4}$ ft. per min., and that of the second mill $23\frac{1}{4}$ ft. per min., ratio of gearing being 19·85 and 18·52 for first and second mills respectively.

The cane chute, it will be observed, is exceptionally steep and long, and arranged in three pieces: the object of this arrangement is to permit of a Krajewski Crusher being inserted at a very early period with the minimum amount of disturbance to the existing arrangements.

The illustration shows very clearly the construction and arrangement of the plant. The top and back rolls of each mill are fitted with scrapers;

the brasses are hollow, with water circulation; the top and side caps carefully grip the mill cheeks; the adjustment of the side rolls is by means of wedge blocks, and the intermediate carrier is of a very special design arranged to take the megass from the first mill and practically force it into the second.

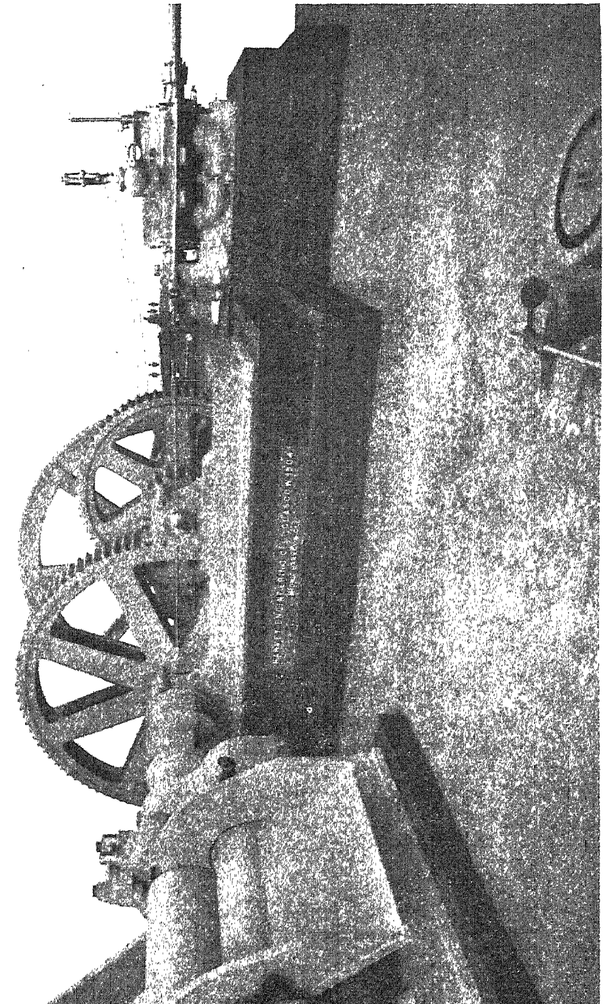
We will next notice the mill design of another well-known firm, Messrs. Harvey Engineering Co., Glasgow, formerly McOnie, Harvey & Co., Ltd. This firm have been engaged in the sugar machinery industry for upwards of half a century, and have almost exclusively confined their attention to this branch of engineering, their machinery bearing a high reputation in all sugar growing countries.

We illustrate on opposite page an example of one of their crushing plants recently supplied for the West Indies. This plant is to be employed for second crushing, and comprises a cane mill having rollers 36 in. dia. × 78 in. long, having gudgeons of best mild Siemens' steel, with journals 18 in. dia. × 26 in. long. The headstocks are of the Rousselot type, of extra weight and strength, the top and side covers being secured by strong steel throughfare bolts. The trash turner is of improved construction with heavy cast-steel bar and special plate with gear for adjustment to top and feed roller. The pinions are of Siemens' cast steel of ample breadth and strength. The bearings are of special hard gun-metal fitted with water jacket and provided with a thoroughly efficient system of lubrication.

The mill is connected by a forged steel tail bar and heavy hooped coupling boxes to a powerful set of compound gearing, contained on a very massive cast-iron base plate, all shafts being of mild Siemens' steel, having extra strong pillow blocks, with gun-metal bushes and strong steel cover bolts. The first and second motion wheels have extra strong arms of box section, made in halves and each fitted with segments of Siemens' steel, the crankshaft and intermediate pinions being also of steel, all being of large pitch and extra broad on face.

The driving engine has a steam cylinder 30 in. dia. × 54 in. stroke, with a piston valve, all of the most improved modern construction. The crankshaft is of forged mild steel with forged steel crank shrunk on shaft, having bearings of heavy gun-metal adjusted vertically and horizontally with wedge and screw action. A large flywheel of extra weight, built in centre, with arms and segments, all properly fitted and bolted together, and turned on rim. The engine is fitted with a strong and well arranged link motion reversing gear, high speed governor, &c., the plant throughout being similar to several others supplied lately by this firm and now successfully at work.

Messrs. Harvey Engineering Co., Ltd., are makers of all sizes of cane mills, and many of their smaller plants, ranging from two tons of sugar per day and upwards, are now doing good work in all parts of the sugar-growing world.



THE MANUFACTURE OF SUGAR IN THE COLONIES.

Since the abolition of bounties on beet sugar in Europe there has been much discussion as to which of the two industries, cane or beet, will obtain supremacy in the world's markets. At a recent meeting of German fabricants, Prof. E. O. Von Lippmann, of Halle-on-Saale, delivered an interesting survey of the conditions of sugar production in the colonies.

He commenced by saying that little information exists as to the economic situation of the colonies outside English and French journals. Only two years ago it was supposed that the colonies made enormous profits even when the price of sugar was 6 marks per quintal (15 francs per 100 kilos.), but to-day we know that this is not so. Passing in review that various centres of cane sugar production, the savant first referred to Egypt, where the sugar cane thrives well, and contains as much as 12% of sugar. The raw sugar factories are perfectly equipped, and a large refinery also exists in this country. Egyptian sugar is mainly shipped to the East Indies, Russian crystallised sugar being imported for consumption, and obtainable below the net cost of production owing to heavy bounties, which, on the other hand, exclude it from British India. The sugar industry in Egypt will extend greatly in the immediate future, benefiting by the irrigation works of French and English companies.

In Natal, as in East Africa (Pangani), the manufacture of sugar has extended but little.

In Mauritius and Réunion, the industry still remains at a very low level, notwithstanding the efforts of eminent agriculturists, such as Bonâme. The effect of the bounties has been to encourage the old routine.

In British India, the native land of the sugar cane, the industry assumes rather a domestic character, palm sugar being also manufactured. The East Indies produce annually two million tons of sugar, but the methods of manufacture are most primitive. This output does not suffice for the local demand, so that sugar is imported from Egypt, Mauritius, Réunion, and even from Germany and Austria.

The Indian Hinterland and the Strait Settlements produce a notable quantity of sugar, but by methods as primitive as in India. So also in China, where little is known about the skill in production. In Japan the cane is only cultivated in the south, and the sugar industry dates from the annexation of Formosa.

In Java, on the contrary, the co-operation of scientists, the establishment of experimental stations, and the wise support of the Government, have raised the sugar industry to a state of great perfection. The cultivation of the cane in this island is nevertheless limited by the necessity of producing rice, whtch constitutes an indispensable food of the native population which is steadily increasing.

Last year, Java produced more than a million tons of sugar, but the cost of production being somewhat high, the manufacture of sugar has not been very remunerative during recent years.

In Australia, Queensland possesses a well established industry, but the cultivation of the cane is costly and consequently restricted. New Caledonia and New Guinea scarcely count. The Fiji Islands produce more, and their production might be increased if sufficient capital were available. As regards the Sandwich Islands, Hawaii is well to the front; and her 58 factories have produced 400,000 tons of sugar during recent years. But the manufacture is only remunerative since her produce has been admitted free to the markets of the United States; and, on the other hand, the cane is seriously threatened by an insect pest, of Australian origin, which has not yet been successfully exterminated.

In North America, notwithstanding heavy protection, Louisiana alone deserves mention as a sugar producer of secondary importance. In Mexico, the industry might be developed, but is at present in a primitive state. In South America, Peru, Equador, northern Chili, and the Argentine, the cane sugar industry is of more or less importance, although little developed from a technical point of view, and mainly supplies the local markets. Similarly with Venezuela and Brazil, where, notwithstanding Government assistance, the progress of the industry is very slow. These countries suffer especially from want of labour.

Among the islands of Central America, Cuba is the most important, the manufacture of sugar having already attained a relatively high degree of perfection and promising considerable extension by the aid of American capital, and more especially if manual labour can be more largely dispensed with. The production for this year is said to amount to 1,400,000 tons.

In Porto Rico modern usines have been erected by French and American capitalists, and the industry enjoys protection raised by American tariffs.

Finally, in the English and French West Indies, the sugar industry is still very backward, notwithstanding the efforts of agriculturists and eminent experts. Considering their high cost of production, the West Indian estates must be materially improved if they are to subsist and develop.

Dr. Von Lippmann hence concludes that great changes and improvements are needed in the Colonies, and that it is essentially necessary to remedy the deficiencies in labour and capital prevailing in these countries if they are to be placed in a position to seriously compete with the European beet industry. Moreover, low prices constitute our most valuable auxiliary in the struggle with cane sugar. The best proof of this being that, since the great rise in prices

in October last, the sugar industry of all Colonial countries displayed extraordinary activity with a view to increasing their production.

If the latest estimates are correct, the deficit in the production of Europe is 21%, but the price has increased 75%. This increase of 75% has given an immense impetus to the Colonial industry, which leads us to the following remarks. The cane is not an annual, but a plant which gives several crops; consequently, as soon as new plantations have been planted up the ratooning of the cane is assured for a long series of years. When once capital is invested in the colonial industry—and with the present high prices this should be easier than in the past—factories will remain in operation whether they yield a profit or not. This is not a very cheerful prospect for beet.

Hence, the excessively high prices of sugar, agreeable as they may be to each of us at the present moment, are a great misfortune for foreign markets as well as for our own, where they compromise the normal development of consumption and threaten, by the subsequent reduction of receipts, to furnish the Government with one more motive for delaying the reduction of the duty on sugar. We have therefore good reason for following, step by step, the development of the Colonial industry.

This account by the German savant was fully appreciated by those present. It will, indeed, be desirable for the European industry to closely watch the economic evolution of its rival under the influence of new conditions brought about by the abolition of bounties and the rise in the price of sugar.—(From *Journal des Fabricants de Sucre.*)

SEEDLING CANES IN THE LEEWARD ISLANDS.

Pamphlet No. 33, issued to-day, contains a summary of the results of the cultivation of seedling and other canes in the Leeward Islands during the season 1903-4. The following extracts from this pamphlet will indicate the nature of the results obtained:—

The canes that gave the best results as plant canes at Antigua last year were: Sealy Seedling, B. 156, B. 306, and B. 208. The same four, but in a different order, head the table of means for three years, and are, therefore, together with B. 109 and D. 95, mentioned as promising canes for Antigua. Judged as ratoon canes, B. 109, Sealy Seedling, B. 306, and D. 95 gave good results. It will be seen that Sealy Seedling and B. 306 have distinguished themselves in Antigua both as plant canes and as ratoons.

At St. Kitt's the first place among plant canes last season was obtained by B. 393, closely followed by B. 208. The latter cane heads the table of means for four years. Among ratoon canes the best were D. 115, B. 306, and B. 208, the same three occupying the head of the table of means for three years, though in different order.

ANTIGUA.—PLANT CANES.

If we take the first seven canes occurring at each station as being above the average, or worthy of attention, and see how far there is agreement between the lists, we obtain useful information. We find that at the eight stations twelve in all have come within the limit of the first seven canes; of these,

B. 306	has come within the first	7 on 8	stations.
B. 156..	,,	7 ,, 8	,,
Sealy Seedling .	,,	7 ,, 8	,,
B. 208..	,,	7 ,, 6	,,
D. 95	,,	7 ,, 6	,,
D. 74..	,,	7 ,, 6	,,
D. 102	,,	7 ,, 4	,,
D. 116..	,,	7 ,, 3	,,
D. 115	,,	7 ,, 2	,,
Mont Blanc ...	,,	7 ,, 2	,,
D. 78	,,	7 ,, 1	station.
D. 130..	,,	7 ,, 1	,,

This is a remarkably close agreement and indicates that Sealy Seedling, B. 306, B. 156, B. 208, D. 95, and D. 74 are calculated to give good returns in all the districts covered by these experiments. That these six canes come out so compact a group affords a sense of security to those who wish to plant them.

ANTIGUA.—RATOONS.

We may classify the ratoon canes, as we have already classified the plant canes, by ascertaining which rank amongst the first seven at each of the six stations. We find that these (7 × 6) forty-two places are occupied by fifteen canes; of these,

Sealy Seedling ..	has come within the first	7 on 5	stations.
B. 306..	,,	7 ,, 5	,,
B. 109	,,	7 ,, 4	,,
D. 102..	,,	7 ,, 4	,,
Mont Blanc	,,	7 ,, 4	,,
B. 208..	,,	7 ,, 3	,,
B. 156	,,	7 ,, 3	,,
D. 130..	,,	7 ,, 3	,,

The rainfall for the season under review was so badly distributed as to handicap severely many of the promising varieties. The bad distribution, however, affords a means of ascertaining which canes are calculated to stand adverse circumstances. In this respect Sealy Seedling and B. 306 appear to have distinguished themselves this season in Antigua, when both plant canes and ratoon canes are considered.

St. Kitt's.—Plant Canes.

Taking the average results for this season, B. 393 occupies first place, followed closely by B. 208. The order for this season is very different from that of last: it is possible that the unusual character of the rainfall accounts for this. The rainfall at the several stations has varied greatly both in quantity and the manner in which it fell; this may have influenced the various canes in different ways.

If we examine the first seven canes at each station, we find that they embrace a greater number than was the case in Antigua, seventeen canes occurring amongst the first seven at eight stations; of these,

B. 393	has come	within	the first	7	on	8	stations.
B. 208	,,	,,	,,	7	,,	6	,,
D. 74	,,	,,	,,	7	,,	5	,,
White Transparent .	,,	,,	,,	7	,,	5	,,
B. 109	,,	,,	,,	7	,,	4	,,
B. 306	,,	,,	,,	7	,,	4	,,
Mont Blanc	,,	,,	,,	7	,,	4	,,

The foregoing seven canes thus appear to be generally suitable over a wide range of soil and climate. This is particularly the case with B. 393, which has suddenly come into prominence in these experiments in St. Kitt's, for it occurs amongst the first seven at all the eight stations, while B. 208 similarly appears at six.

St. Kitt's.—Ratoons.

B. 376	has come	within	the first	7	on	5	stations.
B. 208	,,	,,	,,	7	,,	4	,,
B. 306	,,	,,	,,	7	,,	4	,,
White Transparent .	,,	,,	,,	7	,,	4	,,
Naga B.	,,	,,	,,	7	,,	4	,,
D. 115	,,	,,	,,	7	,,	4	,,
D. 74	,,	,,	,,	7	,,	4	,,
B. 109	,,	,,	,,	7	,,	4	,,

These canes therefore appear suitable for ratooning over the range of soil and climate covered by these experiments. D. 74, White Transparent, and Naga B. possess drought-resisting qualities, while B. 109 and B. 306 require a good rainfall.—(*Agricultural News.*)

NEW CANE PEST IN BRITISH GUIANA.

The *Agricultural News* states that in October last specimens of a butterfly borer were received from Mr. G. N. Bethune, of Plantation Enmore, British Guiana, which was reported to be causing considerable damage to the canes. More recently, the British Guiana Board of Agriculture has sent additional specimens with reports

by the Executive Secretary and the Agricultural Assistant. The following brief description of this pest and the damage caused by it is likely to be of interest:—

The adult of the borer is a large butterfly, with a spread of about three inches, dark brownish-grey above, light-grey beneath. The head is large, with large, prominent, dark-brown eyes. The antennae are about $\frac{11}{10}$ inch in length, slender, swollen towards the tip, the extreme tip being a fine, slightly curved point. The colour of the antennae is dark-brown, lighter at the tip. The fore wing is crossed by a white band from within the middle of the front margin to the hinder angle, with a shorter white band outside it and nearly parallel to it. The hind wing has a white band, which begins with two spots at the front margin and extends back across the wing, increasing in width, so that it is widest near the hind margin. The hind wing also has six pale-orange spots along the margin.

The egg is about $\frac{1}{6}$ inch in length, pointed at each end, with five prominent ribs running from end to end. The colour ranges from a light grey to a dark grey. In captivity the eggs are laid singly, and not attached.

The full-grown larva is about $2\frac{1}{2}$ inches long and $\frac{1}{2}$ inch in diameter at the widest point, which is just behind the head. The colour is a cream white, head light-brown with black mandibles. The young larva enters the cane near the ground, and tunnels a short distance up in the cane and then goes into the underground portion of the stool. Mr. Robert Ward, Agricultural Assistant, states that the cocoon is in the underground portion of the canes. Larvae in captivity at the Head Office of the Imperial Department of Agriculture tunnelled through the ground, and one at least built a cocoon or earth cell in the soil. It is supposed that the adult emerges by means of the tunnels in the cane stumps, but it has not yet been proved whether it has any other way of getting above ground. This condition has suggested the plugging of the holes in the cane stumps with wet clay, which is being tried and some success has been reported. Mr. Bethune reported that he was catching about 1,000 butterflies daily, with nets, in the hands of children.

The damage to the cane by this pest is twofold; the riper cane is severely injured by the large tunnel extending through about two feet of the basal portion, and the stumps are so thoroughly eaten out underground as to make it impossible to ratoon them. It is hoped that a better knowledge of the life-history and habits of this pest will make it possible to apply remedies to prevent damage to canes in British Guiana in future years.

QUEENSLAND.

THE 1904 CANE SEASON.

It is now possible to form a nearly correct estimate of the output of sugar during the past, or 1904-5 season. The mills have all closed down, and the amount of low grade sugars still held in tanks may be roughly calculated without seriously affecting the general result. It will be remembered that in July last we ventured to forecast the output, and our total then was 137,000 tons of raw sugars. From the table which we give below it will be seen that we have reason to think that this output has been exceeded by some 11,000 tons. The difference, it may be said at once, is made by the improved output of the Bundaberg and neighbouring districts. We put that section of the State down in July last for 40,000 tons, but there seems every reason to believe, taking into consideration the reports which have come to hand, that the amount should be more as it is now stated by us. Outside of that district the figures given by us six months ago have proved to be for all intents and purposes correct. There is no question that the crushing season generally has been a highly successful one. The weather has remained all that could be desired, the cane frosted last winter was taken off without serious loss, and there was ample labour, either white or coloured, in the various sugar district to carry on the harvesting operations. Further than this, the cane improved considerably in quality, and the expectations of bad milling cane were not realised. These factors all helped to make the season a good one, if it is judged solely from the harvest point of view. In places there was a lack of rain; which must affect the next crop, both in respect to the young plant cane and also the ratoons of the crop just cut. This, however, did not seriously detract from the satisfaction of the operations just finished. We are sorry to say that no serious attempt has yet been made to test cane-cutting machinery, and an excellent chance has been allowed to slip by of proving whether the devices at present "in ovo" have any possible hope of fulfilling the complicated work in a really heavy crop of cane. Nor can it be said that in other directions there was much that was new or economical introduced this year into the fieldwork. In the mills the David's cane loaders, or adaptations of them, are at last finding a place, and their work, so far as we can learn, has been giving every satisfaction. The saving effected in actual cost is alone an important item, but it is more important still that mill managers should be freed of the anxiety and worry of endeavouring to keep a large staff of white men at work at the cane-carriers, the labour at which appears more than ordinarily distasteful to the average European. The main disadvantage of the unloader so far appears to to be its want of adaptability to conditions where drays as well as trucks are delivering cane at the carriers. At one mill in the Mackay

district the management insists upon all cane being delivered by tramline, thus enabling them to utilise the unloader to the fullest extent. For the first time in their history all of the central mills have been under chemical control, carried out on one definite plan. They have also been visited by an official of the Bureau of Central Sugar Mills. The results when published should prove to be interesting and valuable. Some interest, unfortunately mostly political, will be taken in the results of the employment of white labour in the canefields during the past crushing. From the Burdekin northwards the matter is of really little interest to the people. Comparatively speaking a very small quantity of cane is cut by white labour, not necessarily because Europeans are so much more expensive, but simply because they cannot get the men all the year round in sufficient numbers to enable them to maintain the qualifications of their lands for the earning of the Federal bonus on white-labour grown cane. The conference held in Townsville during the latter part of last year is sufficient evidence of the truth of this general statement. In the Proserpine of Bowen district there is a large group of small cane-growers, and none of these, we believe, employ coloured labour, but on the other hand it cannot be denied that the mill is benefiting considerably by the purchase of a very considerable quantity of cane which is actually grown by coloured aliens, who work their own farms. In the Mackay district about half the crop was taken off by white labour. There is one large plantation, and also several small ones, which employ coloured labour, while there is also a number of coloured aliens growing cane on their own account. While about half the crop was cut with white labour, it must be borne in mind that in the Mackay district there are hundreds of small farmers, many of whom employ no labour at all outside that of their own families. Indeed, it is safe to say that a large proportion of these growers never did employ coloured labour, and Federal legislation has consequently come to them as an unexpected boon, a free gift, for which they imagine they sacrifice nothing. Further south again there has been a smaller proportion of cane cut by white labour. The large plantations in the Bundaburg district effectually preclude the raising to any very great extent of the proportion of white-grown cane. About the Brisbane district we believe the whole of the cane is practically white grown, except where coloured aliens are actually growing cane themselves. On the whole it must be admitted that, under all the circumstances, the white labour policy has not advanced very much during the past season. It has been frequently contended that white men would be very much more anxious to take up the work if the crops were heavy, but this past year the crops have been heavy, and the results have been little if any better. The continuance of the bonus is certainly the only hope either growers or politicans can have that the policy will develop successfully. The other principal factor which operated with

the heavy crops in making the past season successful was the price of sugar. At the commencement of the season there was some anxiety and surprise, when it was learnt that the refiners had reduced the price of raw sugar by 9s. per ton. This reduction, however, was subsequently found to be partially balanced by a reduction in the level of rates for refined, by which the amount of bonus on raw sugars is calculated. Since last July the refiners have succeeded in establishing several advances in the prices of refined, all of which of course carry an increment to the bonus on raws. It is not necessary to discuss the cause of the rise, except to say that the improvement in prices in Australia is in sympathy with the advances in sugar values all over the world. It is now anticipated that the bonus at the end of next June will be about 36s., which means that the price of 94 per cent. sugar will be about 13s. a ton higher than it was for the 1903-4 season. We need hardly point out than on a crop of 150,000 tons of sugar this improvement in price amounts to a very considerable sum. The past year has therefore been a distinctly profitable one. It is doubtful if there is any mill in the State, working at all under average conditions, which did not make a very considerable profit, after paying interest and redemption on the capital invested, whether to the Government or to the private individual or institution. In the following table will be found the outputs of the various districts for the last two preceding years, the figures of the first two years being official, and of the last, our estimate:—

District.	1902. Tons.	1903. Tons.	1904. Tons.
Brisbane	493	3,371	3,500
Bundaburg, Maryborough, Gin Gin and Childers	6,647	15,691	50,000
Mackay, Bowen	18,692	21,033	32,500
Burdekin	5,714	7,400	11,000
Herbert, Johnstone	26,710	24,548	26,000
Cairns, Port Douglas	18,370	19,785	25,000
	76,626	91,828	148,000

(Mackay Sugar Journal.)

The strikes which have been so prominent of late in Russia have affected the sugar industry amongst others. All the sugar refineries in Poland are concerned.

GERMAN SUGAR IN INDIA.

The Consul-General at Simla's Report.

One can only suppose, says the *Pioneer*, that Reuter has in some way done less than justice to the "striking report" of the German Consul-General at Simla on the Indian sugar duties. It is certainly not in accordance with the facts to say that "the Indian differential duties on sugar have practically killed the German and Austrian imports into India." If the Report had been written before the beginning of 1904, that statement might have been at least partially true, for the frankly protective duties imposed by Sir Edward Law in May, 1902, certainly had the effect of temporarily destroying the trade in Continental beet sugar. But with the removal of the prohibitive duties the Continental export trade to India at once began to revive, and though it has not yet recovered the enormous proportions of four years ago, that is by no means solely in consequence of any duties imposed by the Indian Government. With regard to Germany, it may be pointed out that as a matter of fact the countervailing duties imposed by the Indian Government had less to do with the decline in the volume of her sugar trade with India than had the competition of Austria-Hungary. Eight years ago Germany was the leading exporter of beet sugar to India, but Austrian competition grew apace, and in 1898-99, while German exports fell from 1,203,309 cwt. to 413,971, Austrian exports showed a considerable increase.

The Effect of the Countervailing Duties.

Then came the first imposition of countervailing duties, and the effect of these being exaggerated on the Continent, both Austrian and German exports fell—the latter to the trifling figure of 60,526 cwts. But it was soon seen that the effect of these duties could be evaded; Austria developed and perfected the Cartel system, and her exports increased until they threatened to swamp the Indian market and destroy the indigenous industry altogether. In two years they jumped from less than eight hundred thousand to two and a quarter million cwts., while the German trade, being less perfectly organised, could only expand to 577,139 cwts. In May, 1902, came Sir Edward Law's definitely protective duties, and in two years both the Austrian and the German sugar trade were temporarily wiped out. But that the effect was only temporary the latest trade figures demonstrate very clearly. Between April and December of 1903 Austria-Hungary only exported 11,495 cwts. of sugar to India; in January, 1904, she sent us 33,767 cwt., and in April and May 457,403 cwt. In the eight months between April and November, no less than 909,172 cwt. of sugar was imported into India from Austria-Hungary, as compared

with 9,865 cwt. in 1903, and 866,177 cwt. in 1902. Though the imports from Germany are not nearly so large, that country has already recovered the position she occupied in 1902, her exports having risen from 4,589 cwt. in 1903 to 141,759 last year. It is quite true that the imports of sugar from Mauritius and Java have increased enormously, but at the same time it must be remembered that the Continental beet crop is a very short one owing to drought, the shortage being estimated at nearly a million tons, and with the price of sugar rising in European markets, there is naturally not so much available for export to India, which has always been in the main a dumping ground for surplus stock. There seems to be a considerable amount of vitality still about a trade which has expanded in value from less than 1½ lakhs to well over a crore and two lakhs in twelve months, despite a short crop and increased prices in other markets.

NATAL TARIFF CHANGES.

Revised Customs Regulations have recently come into force in Natal for dealing with the importation of sugar from countries not parties to the Brussels Convention.

Under the present Regulations the following special (additional) duties over and above the ordinary duties and surcharge, have been fixed provisionally for the under-mentioned countries:—

Countries.		Sugar. Raw. s.	d.	Refined. s.	d.
Denmark	per 100 lbs...	0	7½	1	3
Spain	,, ..	9	8½	9	8½
Japan	,, ..	—		0	11¼*
Argentine Republic..	,, ..	18	0	18	0
Roumania	,, ..	6	4½	8	1
Russia	,, ..	2	2¾	2	11¼
Chili	,, ..	2	1¾	4	9

The Essex County Council are about to undertake experiments with a view to ascertaining the natural qualities of the county for the cultivation of sugar beet.

* Candied Sugar.

THE FUTURE OF BEETROOT CULTIVATION IN FRANCE.

By M. Helot.

The economic life of a country should never be considered from day to day, for it is of the utmost importance to reckon in advance with future conditions in order that lessons may be deduced and made known through the agency of such an Association as ours.

In a report presented to the Chamber of Commerce of Cambrai, in March, 1902, I indicated the overstocked condition under which the sugar industry had struggled during the past year or two before a balance was re-established between supply and demand.

During the following year I set forth the conditions which, in my opinion, would bring the crisis to an end by averting dangerous over-production, and predicted that, in two years' time, it would be found necessary to erect new sucreries to satisfy the demands of non-producing countries.

If, when referring to those legitimate demands, we had more forcibly expressed our convictions as to the need of future caution in the administration of our great agricultural industry, we might, perhaps, have prevented discouragements. We should have guarded against the disrepute in which the leading banks have held this industry for some months, and which, since the crisis, has caused 40 usines to be closed, which might otherwise have benefited the agriculture of their districts, and co-operated in supplying export markets.

To-day I wish to inquire whether the high price of sugar, which so astonishes the world, is likely to be followed by a dangerous re-action. Is the sugar industry passing to a state of more permanent stability, or are we progressing towards a new crisis of over-production? I shall attempt to elucidate the following points:—

1. Whether a reduction in the consumption of sugar is to be feared.

2. Whether the development of the cane industry threatens to be detrimental to that of the beetroot.

3. And, finally, whether the increased beet sowings appear sufficiently extensive to restore the important stocks with the briefest delay.

I would also deduce certain advice for our French agriculturists, in districts where the beetroot is cultivated, to preserve them as far as possible from the instability from which they are suffering. In order to examine the present situation and to forecast the future, it will be necessary to consider statistics which will occasionally be based on hypotheses, for it is impossible to determine the situation of our great agricultural industry two years in advance without arguing on probabilities.

The commerce in sugar is essentially international; therefore, an inquiry into the future of the beetroot necessitates a consideration of the universal market. The scarcity of sugar can never be more than

temporary, for high prices lead to an increased production of so indispensable a food. That portion of the world's supply contributed by France corresponds to the natural richness of her soil and to the immense resources of a country which should be better equipped than others. In Europe, since the Brussels Conference, the natural situation of any country whatsoever has only a relative and limited importance in the world's markets. The sugar industry no longer rests on a false footing due to legislative or private combinations, but each country is really free to utilise its own forces to its own ends.

We should not allow ourselves to be outdistanced by our European competitors in the export market, and we should come to an understanding with them to prevent cane sugar from gaining a footing in the old world. The excessive increase in the production of sugar is not in keeping with the regular increase of the world's population, which calls for an annual increase in consumption of 4 %; and the progress of civilisation must inevitably extend this consumption. Finally, the reduction of duties falling on the consumer increases still further the demands by consumers if its effects are not paralysed by exclusively high sale prices. These general principles being established, let us now look at the facts.

The importance of accumulated European stocks, under the regime of bounties and cartels, had so lowered the intrinsic value of sugar that a reduction in the beet sowings followed as a necessary consequence. The last crop, which was the worst that has been known, completed the effect of the reduction in the area sown. On the other hand, the reduction of the tax, following the Brussels Convention, the necessity of restoring the exhausted reserves in view of the change of regime, and, finally, an exceptional fruit crop, have been so many causes of the supplementary consumption of 710,000 tons of sugar in France, Germany, and Austria-Hungary, during the year which terminated in September last.

Before proceeding further, it is important to eliminate from our enquiry certain elements which may be left out of consideration. We shall not refer to the production of the East Indies, although the largest in the world and estimated at 3,000,000 tons. Although these sugars are of bad quality and are consumed by the natives, they may yet prove a menace in the future. The United States, with Cuba, Porto Rico, the Philippines, etc., need not detain us. Cuba is said to be capable of producing 1,400,000 tons of sugar, but it is not probable that such an output would find a market. It is certain that existing prices have given an impetus to the production of sugar from the cane, which profits by the difference between 20 frs., the lowest price, and 40 frs., the present price, while beet sugar is bound to compensate for that rise in price by the bounties suppressed. Moreover, whilst the system of bounties are being abandoned in Europe, the United States grants them to Cuba, the Philippines, and Porto Rico.

Notwithstanding this, statistics show that if the United States will no longer take from Europe the 100,000 tons required last year, they will easily absorb the supplementary production, even if this amounts to from 300,000 to 400,000 tons, as estimated to-day. I think we may therefore admit that American statistics will not influence European ones during the campaign 1904-5.

Java, which, at a price of 17 frs. per 100 kilos, has been able to increase her production from 650,000 tons in 1899, to 1,050,000 tons in 1904, without the aid of bounties, and which appears to have extended her estates by 10%, should be able to expand her productive power to its maximum. Cuba may be expected to reach the culminating point of her production this year. Scarcity of labour will be an insurmountable obstacle; and, I repeat, American prosperity would be able to absorb the anticipated increase in these countries.

British Guiana and Mauritius are increasing their shipments to English markets, owing to the improved prices. The French colonies, thanks to the unlooked-for prices, are able to maintain their production, but not to increase it. We now return to the situation in Europe, and proceed further with our process of elimination.

Russia, notwithstanding an expected shortage of 250,000 tons in her production for 1904-5, will dispose of an amount equal to that of her export production last year. In fact, excluding the countries adhering to the Convention, these sugars no longer go to England, where heavy stocks are still on hand. It follows that this country has found new markets. Owing to high prices and the want of money resulting from the present war, Russia will be induced to compete principally with France and Austria-Hungary, in Switzerland and in the Mediterranean. This supplement to the export market may be estimated at from 200,000 to 300,000 tons.

We may neglect Sweden, Denmark, Holland, Belgium and Italy, which have little or no influence on the London market, and there remain the three large sugar producing countries of Europe, which alone rule the markets of Paris, London, and Hamburg.

As the sugar market is international, it is useless to complicate my statement by detailed statistics for each of these three countries and I shall consider the general resources of France, Germany, and Austria-Hungary together.

By the 1st September, 1905, these resources will amount to 3,855,000 tons, comprising 765,000 tons in stock on 1st September last, and 3,090,000 tons, the estimated production for the present campaign, as furnished by the International Association of Statistics, including 90,000 tons from the French colonies. What will be the presumable destination of this supply? Generally speaking, the increased consumption of 710,000 tons by the three countries under consideration during 1903-4, must not be regarded as definitely ascertained. We must not lose sight of the fact that the year which

has seen this enormous increase in consumption has benefited in three ways, each of which was favoured by the low price of sugar:—1st, the necessity of replacing those particular supplies which were exhausted when the change in legislature occurred; 2nd, the reduction of the duty; and 3rd, the exceptionally large fruit crop. High prices have inevitably restricted the consumption of sugar, at all events, in appearance; and the invisible stocks remain to be exhausted. On the other hand is it possible to reckon upon a second fruit crop as abundant as the last?

Taking each of these causes into consideration, I estimate the reduction in the consumption for these three countries at 350,000 tons. Up to the end of November this reduction amounted to 208,000 tons. If, then, from the supply of 3,855,000 tons we deduct 1,980,000 as the probable consumption for 1904-5, there remains 1,875,000 tons to be disposed of by exportation from the same three countries. This figure should be increased to 200,000 or 300,000 tons which Russia will in any case export to Turkey, Switzerland, the Levant, Morocco, etc.

We have seen that the United States will no longer require the 100,000 tons taken from last campaign. England not being accustomed to paying the present price for her sugar, those industries which employ sugar suffer, and the working classes will resent the cost of a food being doubled since the South African war. I attribute to these facts the reduction of the demand by 250,000 tons on the available export supply of 1,875,000 tons, so that instead of exporting 1,705,000 tons, as in the previous year, the export from the three producing countries will not be more than 1,455,000 tons for the present campaign.

By the 1st September, 1905, the stocks for France, Germany, and Austrio-Hungary will amount to about 400,000 tons. This will cause a scarcity of sugar if at that period the manufacturing season should not promise an abundant supply, or should commence late.

How may this future production be estimated? We must assume as a basis that the next crop will yield an average return of a normal season. Since 1901-2 Germany has only very slightly reduced the area reserved for beet cultivation; Austria-Hungary has reduced this area still less; whilst France, being the most affected by the abolition of bounties, has been compelled to reduce her cultivation to a much greater extent.

Might one estimate that these three countries will increase their sowings for 1905-6 in such a proportion that their crops will return at a bound to a maximum of, say, 2,300,000 tons for Germany, 1,300,000 for Austria-Hungary, and 1,100,000 tons for France? Certainly, in the case of Germany and Austria, for we have seen that our competitors have proved much more stable than ourselves during critical periods. We shall, therefore, reckon the next crop of these

two countries as being equal to that of 1901-2, (it cannot be presumed that these figures will be exceeded), for it is quite possible for a very poor crop to be followed by an abundant one.

As regards France, the increased production would have to be much greater before the highest returns for 1901-2 are reached, and this is hindered by three causes:—1st, The rotation of crops has been profoundly disturbed for the past three years; 2nd, The closing of forty usines will appreciably diminish the production; and 3rd, The competition of the beet distillery, in view of the high price of alcohol, will be keenly felt. In addition to this, the shortage of fodder will induce the cultivator to profit by the remunerative prices offered him for his stock of pulps. This requirement will be the more urgent if the want of money and fodder have, by reaction, brought about a reduction in the value of lean animals in districts devoted to cattle breeding, for, by turning to the manufacture of manure, the cultivator could most quickly make a profit. For these several reasons, one might expect a probable production of 900,000 tons of sugar in France for the season 1905-6 if all goes favourably.

There will then be 2,300,000 (from Germany) + 1,300,000 (from Austria-Hungary) + 900,000 (from France) + 400,000 (in stock on 1st September, 1905) + 100,000 (imported from the French Colonies), making in all 5 million tons available for 1905-6. The same methods of reasoning from the present to the future campaign may also be applied to Russia, and other countries which are secondary producers. I assume that like causes will produce like effects.

What may we suppose will be the probable consumption in 1905-6? On the same grounds that I predict for 1904-5 a restriction of consumption, and especially an exhaustion of invisible stocks, I am convinced that the latter part of next year will see a recrudescence in commercial activity, for there should be many demands to meet from the month of October. Moreover, the gradual and continual increase in consumption, which we have intentionally omitted to take into consideration, and which has caused the present high prices, will recover all its force and influence during the present campaign. I am convinced that the consumption in France, Germany, and Austria-Hungary might reach 2,500,000 tons in 1905-6. There will therefore also be 2,500,000 tons available for the export market. Like causes having like effects, it is probable that the export demand may amount to 1,850,000 tons, which will leave a stock of 650,000 tons for September 1st, 1906, for the three large producing countries, or an amount equivalent to about two months' consumption. The stocks of 400,000 tons for September 1st, 1905, do not justify these high prices, provided that no serious accident occurs to the next crop. Nor can the estimate of 650,000 tons in stock on September 1st, 1906, create the fear of low prices unless the sugar cane has some improbable surprise in store for us.

Under these conditions the large increase in production is absolutely justified, and we may say that in the spring of 1906 the three countries under consideration should still further increase their sowings in order to cope with the demand in 1906-7.

In the course of this inquiry I have always assumed that by incessant progress we shall be able to exclude cane sugar from our Continental markets, but it is necessary to note that in other markets cane sugar is securing a more and more prominent position. After the present war, the far eastern countries will unquestionably be more widely opened up to the wants created by civilisation; we shall share their market with cane-growing countries, and shall probably find a compensation in the increased export of beet sugar to Japan, Canada, British Indies, &c.

We, in France, must never forget that our export will always be paralysed so long as we artificially maintain prices below those current in London and Hamburg. Nor should we lose sight of the fact that each time that the price of No. 3 sugar exceeds 35 francs we arrest the indispensable progress of consumption and favour the competition of the cane. Finally, we must convince ourselves that at this price of 35 francs, the industry must live and let the beet cultivator live also.

I am naturally diffident in forecasting hypothetical conditions so far ahead; yet I consider that wise forethought necessitates an attempt to penetrate the obscurity of the future in order that we may follow the wisest course under normal conditions. Having considered what ought to be done, it may be necessary to modify our views when atmospheric conditions or other unforeseen events happen to upset our most cautious calculations.

I refer not so much to uncertain incidents which may temporarily raise the price, but have mainly sought to enquire whether agricultural stability is such as to allow the continued cultivation of the sugar-beet in its rotation of crops. Passing from one deduction to another, I have arrived at the conclusion that the crisis is absolutely over, and that its return need only be feared when high prices favour the excessive development of the sugar cane.*

Table representing Statistics for the Campaign 1903-4, compared with those expected for 1904-5.

	Production.		Consumption.	
	1904-5.	1903-4.	1904-5.	1903-4.
Germany. . . .	1,550,000	1,930,000	970,000	1,135,000
Austria..	900,000	1,175,000	450,000	510,000
France	550,000	725,000	560,000	685,000
,, Imported..	90,000	90,000	....	....
	3,090,000	3,920,000	1,980,000	2,330,000
Reduction ..	830,000	....	350,000	....

* The author of this paper insists on the necessity of regarding his deductions as based on reasonable probabilities which must always remain hypothetical.

	Exports. 1904-5.	Exports. 1903-4.		Final Stocks. 1904-5.	Final Stocks. 1903-4.
Germany	700,000	870,000	..	125,000	245,000
Austria	520,000	600,000	..	70,000	140,000
France..	235,000	235,000	..	225,000	380,000
	1,455,000	1,705,000		420,000	765,000
Reduction . ..	250,000	....		345,000	....

Table representing the anticipated Statistics for the Campaign 1905-6.

	Production.	Consumption.	Export.	Final Stock.
Germany.. . ..	2,300,000	1,220,000	950,000	255,000
Austria..	1,300,000	550,000	650,000	170,000
France	900,000	730,000	250,000	245,000
,, Imports....	100,000	..	....	....
	4,600,000	2,500,000	1,850,000	670,000

—(From *La Sucrerie Indigene et Coloniale.*)

Correspondence.

MAURITIUS.

To the Editor of "The International Sugar Journal."

Sir,—The March number of your journal contains an article on Mauritius, entitled "A Plea for Social Reform," which I have read with the greatest surprise and indignation. As a Mauritian and Representative of the Municipality and the Chambers of Commerce and Agriculture of that Colony, I feel it my duty to enter the most emphatic protest against the sweeping charges made by your correspondent.

That "great improvement could be made in the colony by a proper "system of land drainage, water storage, and the re-planting of part "of forests," no one has for a moment doubted. As a matter of fact, these improvements, retarded so long by the lack of funds, have for some time past been under execution. For instance, the "Mare aux Vacoas," formerly a muddy swamp, has been deepened and dredged; large filters have been placed on its banks, and it now supplies several districts with drinking water. I admit that during the dry season this water is not of the best quality, but this is not the fault of the engineers who carried on the work; it is due to the inexorable climate of the tropics. The "Forest Board" has also taken in hand the re-planting of the forests, and from time to time the Government purchases as much land as its resources will permit, in order to plant

new trees so as to increase the rain-fall, and consequently the prosperity and salubrity of the Island. The drainage of the town of Port Louis has also been carefully studied by the Municipal Council; part of it has already been completed, and the work is steadily proceeding.

I am at a loss to understand how a journal such as yours, which is extensively read in the colonies, could have undertaken the publication of the imputations contained in certain paragraphs of the article against the inhabitants of a British colony, who, although of French descent, have always shewn their loyalty and devotion to their Sovereign and to the Empire. Their character is magnificently vindicated in a book, "Colonial Memories," written by Lady Broome, wife of Sir Napier Broome, one of the former Governors of the Colony.

Your correspondent admits that "the planters have retained (to "some extent) the reputation of enterprising sugar growers and "manufacturers," although, to quote again his own words, "they "have much degenerated and have become ignorant, lazy, corrupt "and boastful." As a matter of fact, several Englishmen have tried their hands at sugar growing in the colony, and none of them seem to have prospered in the same ratio as the native born—"superior ability and honesty" notwithstanding!

As regards the language spoken in the Island, your correspondent has very likely been unable to obtain admission into the upper circles of Mauritius society, otherwise he would have found that English and French only are spoken, and that "the Creole-French dialect, with some small admixture of Indian words" is only employed by servants and labourers. There is in Mauritius a Board of Education, and a Director of Public Instruction. The schools number 72, and there is an average attendance of 9,322 pupils, as per Mauritius Almanac, 1904. Amongst these, a certain percentage are sent over every year to England, either by their parents, or by the Government as Scholars of the Royal College, to terminate their studies, and most of them have been very successful in this country. At Oxford, Cambridge, Cooper's Hill, the City and Guilds' School of Engineering, Guy's Hospital, etc., they have competed with students from all parts of the Empire, and have come out of the ordeal with honours, winning many scholarships. It is, no doubt, for this reason that their services have been later on appreciated by the successive Governors of Mauritius, who have nominated them to the vacant posts in the Civil Service, when their length of service and their capabilities justified their choice, to the great annoyance, no doubt, of certain recently arrived Englishmen, who seem to think that their nationality is a sufficient motive for rapid promotion to the highest posts and the best salaries.

The contention that, because "they distrusted each other too much "for that, the Planters did not even employ an Agent in Bombay to

"watch the prices of sugar, thus allowing the Arab Merchants to buy "up the crop piecemeal, and then to put the prices up," is too childish to need discussing. Let it suffice that all the principal business houses and brokers of standing have their own Agents in India who keep them well posted, and when it was learnt that prices were also on the rise in Europe, the Chamber of Brokers appointed, as its Agents in England, my firm, Chalmers, Guthrie & Co., Limited.

When the "sura" or murrain made its appearance, the Planters were very glad to obtain a loan from the Government, through the instrumentality of their much respected and esteemed Governor, Sir Charles Bruce, G.C.M.G., who has spent a large part of his life in the colony, and who has always taken a great interest in its welfare. His splendid work in connection with Mauritius was so well appreciated by the colony, that, when the term of his office was drawing near a close, a Resolution was moved by the Leader of the Opposition, and carried unanimously, asking the Colonial Secretary to be good enough to extend the time of his Governorship,—a favour which was granted by the Minister,—and is an act almost unprecedented, I believe, in the annals of the colonies.

"Although favoured by the largest crop ever known, the planters "were not too proud to request that the first instalment of interest "might be postponed." This is a fact, but your correspondent omits to mention the important point that the prices obtained for this largest crop were the lowest on record, and did not, in most cases cover the cost of production. The Mauritius planters, however, did not ask for a grant in aid, but applied for a loan at 5% interest, feeling sure that the time was not far distant when more prosperous times would be in store for them, which would enable them to retrieve their position. Their hope has not been vain, for prospects are of the fairest "now that the clog of sugar bounties is removed."

I am not afraid of being contradicted when I state that views such as those expressed by your anonymous correspondent will meet with very little approbation in this country, more especially his scarcely veiled hint that now is a suitable opportunity for ousting the present planter in favour of foreign capitalists. I have lived in England many years; I have studied the true spirit of the English, and I make bold to state that this is not the kind of treatment that is meted out by them to British colonists.

To attribute the general neglect of sanitary precaution "partly to "the venality of the lower members of the medical profession" is an unwarrantable attack upon a body of very able practitioners, who have never failed to do their duty whenever an epidemic has spread itself over the colony. I challenge your correspondent to prove his statement concerning them, and also concerning "the "inferior magistracy, the lower rank of officials, and many of the

"business men." As representative of the Municipality of Port Louis, I must protest against his insinuations respecting the ex-Mayor of Port Louis, which are most unjustifiable, and can only be attributed to your correspondent's prejudice, or to his desire to throw discredit upon everybody connected with the affairs of the colony who is a Mauritian. The actual facts of the case he cites are these:—As there was some doubt as to the necessary quorum in a Revising Committee, the Mayor interpreted the law (which had recently been passed) to the best of his knowledge, and in this he was not in accord with some of the Municipal Councillors, who, in order to test the case, brought the matter before the Supreme Court, whose verdict went against the Mayor. I contend that the latter acted in his official capacity and in perfect good faith, and cannot consequently be blamed if he charged the costs of this test case to the municipal funds: it is therefore natural that "he was not removed nor called "upon to resign," and I may add that he was not compelled to repay the amount.

Another misrepresentation on the part of the writer of the article is that "Nominees have hitherto been allowed to vote as they please." This is not the case; their vote is always at the disposal of the Government, but in certain cases of little importance the Governor allows these gentlemen to vote in the manner which seems to them equitable, but on a question of public interest they are bound to vote with the Government. The Indians have one representative in the Assembly: your correspondent suggests that this is not sufficient, as they out-number the creoles by more than two to one. The latter, however, constitute the more educated part of the community, and in this may be found the explanation of this state of affairs. In England the labourer is also numerically in excess of the middle class; how many Labour members are sitting in Parliament to represent him?

It is outside my province to comment on the advice given by your correspondent to the Governor of the Island. We can trust to Sir Cavendish Boyle's experience and ability to safeguard the interests of our colony, and promote the welfare of its people.

I remain, Sir, yours truly,

MAURICE ULCOQ,

Agent General of the Municipality of Port Louis.

9, Idol Lane, E.C.,
March 16th, 1905.

AUSTRIA-HUNGARY.

Trieste.—Owing to the dryness of the summer the beetroot crop in Europe in 1904 was not abundant. Consequently the production of sugar was 1,150,000 tons less than in 1903, and prices rose.

The market prices at Trieste for transit sugar, freight free, Trieste, were:—

	Beginning of January 1904. £ s. d.		End of December, 1904. £ s. d.
Centrifugal	1 1 0	....	1 13 0
Melispilé	1 2 1	....	1 15 0
Powdered sugar	1 0 0	....	1 12 6

Exports of sugar to the British East Indies have increased through competition in shipping, which brought freights down to 10s. and even to 9s. per ton, whereas the Austrian Lloyd's rate was formerly 17s.

During 1904 Austrian produce competed successfully against foreign countries.

Exports of Sugar from Trieste, by Sea and Land, during the Years 1904–1902.

	Quantity. 1904. Met. tons.	1903. Met. tons.	1902. Met. tons.
By sea—			
America, &c.	170	290	140
Bulgaria	3,450	3,000	3,000
India	26,350	5,130	47,200
Egypt	2,970	2,280	6,600
Italy	1,080	1,300	4,720
Istria and Dalmatia	4,470	3,830	3,370
United Kingdom	400	2,390	2,500
Gibraltar	350	470	550
Greece (Ionian Islands, Candia)	8,770	9,590	10,360
Malta, Massowah, Aden, Zanzibar, &c.	6,130	8,610	8,270
Montenegro	100	160	140
Roumania	80	140	80
Japan and China	580	11,170	12,660
North Africa	3,200	3,880	4,480
Turkey	66,650	72,710	94,780
By land—			
To different countries	1,210	1,320	1,250
Total	125,960	126,250	200,100

PUBLICATIONS RECEIVED.

Hacendado Mexicano's Yearly Sugar Report 1904-05. Hacendado Mexicano Office, Apartado 2010, Mexico City. Price $5·00 This annual report issued from the office of the organ of the Mexican sugar planters contains a list of cane growers and sugar manufacturers in Mexico, Central America, Porto Rico, Cuba, Argentina, Peru, Hawaii, and Java, and gives the reader figures relating to the amount of sugar and molasses made during the grinding season of 1903-4. An interesting map of Mexico, showing the localities of the sugar factories, is included.

MONTHLY LIST OF PATENTS.

Communicated by Mr. W. P. Thompson, C.E., F.C.S., M.I.M.E., Chartered Patent Agent, 6, Lord Street, Liverpool; and 322, High Holborn, London.

ENGLISH.—applications.

3827. J. Robin-Langlois, London. *Improvements in and relating to machines for the manufacture of sugar.* (Date applied for under Patents Act 1901, 11th March, 1904, being date of application in France.) (Complete specification.) 23rd February, 1905.

3972. V. Schütze, London. *Process of and apparatus for the production of crystals from sugar solutions and the like.* (Complete specification.) 25th February, 1905.

abridgments.

2928. L. Naudet, Paris, France. *Process of and apparatus for the diffusion and extraction of saccharine juices.* 5th February, 1904. This invention has reference to the diffusion and extraction of saccharine juices, and has for its object a process of and apparatus for diffusion by forced circulation at a constant speed automatically maintained.

Copies of all published specifications with their drawings in these lists can be obtained from W. P. Thompson & Co., 6, Lord Street, Liverpool, at One Shilling a copy for English or American Patents, and Two Shillings for German. In ordering please give number and date.

IMPORTS AND EXPORTS OF SUGAR (UNITED KINGDOM)

To end of February, 1904 and 1905.

IMPORTS.

Raw Sugars.	Quantities.		Values.	
	1904. Cwts.	1905. Cwts.	1904. £	1905. £
Germany	1,069,557	502,306	455,142	369,448
Holland	59,499	65,345	23,435	48,437
Belgium	38,535	201,697	14,812	153,404
France	12,525	10,968	5,868	8,200
Austria-Hungary	331,311	114,490	156,635	83,892
Java	188,135	653,408	83,999	495,438
Philippine Islands	....	....	....	....
Cuba	....	....	....	....
Peru	187,840	273,829	82,294	206,652
Brazil	60,146	19,085	23,721	13,194
Argentine Republic	....	....	....	....
Mauritius	60,516	47,345	22,134	27,820
British East Indies	27,551	24,052	11,789	12,330
Br. W. Indies, Guiana, &c.	126,362	223,434	78,792	194,158
Other Countries	50,542	154,768	24,419	116,828
Total Raw Sugars	2,212,519	2,290,727	983,040	1,729,801
Refined Sugars.				
Germany	1,350,208	1,514,689	743,276	1,301,548
Holland	474,563	279,552	277,472	246,759
Belgium	48,821	65,738	27,678	57,359
France	226,482	125,662	121,850	112,579
Other Countries	114,932	39,952	60,215	34,847
Total Refined Sugars	2,215,006	2,025,593	1,230,491	1,753,092
Molasses	237,169	248,603	45,932	64,742
Total Imports	4,664,694	4,564,923	2,259,463	3,547,635

EXPORTS.

British Refined Sugars.	Cwts.	Cwts.	£	£
Sweden and Norway	3,631	4,768	2,102	4,089
Denmark	16,368	14,432	8,563	11,786
Holland	9,678	12,493	5,031	10,823
Belgium	2,086	863	1,130	676
Portugal, Azores, &c.	1,225	2,728	776	2,173
Italy	1,091	....	516	....
Other Countries	42,388	30,661	27,997	29,409
	76,467	65,945	46,115	58,956
Foreign & Colonial Sugars.				
Refined and Candy	3,511	3,057	2,621	3,002
Unrefined	10,823	8,511	5,756	7,068
Molasses	25	190	11	81
Total Exports	90,826	77,703	54,503	69,107

UNITED STATES.

(Willett & Gray, &c.)

(Tons of 2,240 lbs.)	1905. Tons.		1904. Tons.
Total Receipts, Jan. 1st to March 16th..	435,243	..	382,414
Receipts of Refined ,, ,, ,, ..	100	..	25
Deliveries ,, ,, ,, ..	431,610	..	371,509
Consumption (4 Ports, Exports deducted) since 1st January	318,250	..	321,705
Importers' Stocks (4 Ports) March 15th..	3,633	..	23,066
Total Stocks, March 22nd..	217,000	..	129,766
Stocks in Cuba, March 22nd	252,000	..	248,412
	1904.		1903.
Total Consumption for twelve months ..	2,727,162	..	2,549,643

CUBA.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1904 AND 1905.

(Tons of 2,240lbs.)	1904. Tons.		1905. Tons.
Exports	268,503	..	291,652
Stocks	206,718	..	239,392
	475,221	..	531,044
Local Consumption (two months)	7,950	..	8,150
	483,171	..	522,894
Stock on 1st February (old crop)	94,835	..	—
Receipts at Ports up to February 28th ..	388,336	..	522,894

Havana, 28th February, 1905.

J. GUMA.—F. MEJER.

UNITED KINGDOM.

STATEMENT OF IMPORTS, EXPORTS, AND CONSUMPTION FOR TWO MONTHS ENDING FEBRUARY 28TH.

SUGAR.	Imports. 1905. Tons.		1904. Tons.		1903. Tons.	Exports (Foreign). 1905. Tons.		1904. Tons.		1903. Tons.
Refined	101,279	..	110,750	..	124,687	153	..	175	..	167
Raw	114,536	..	110,626	..	90,376	425	..	541	..	259
Molasses	12,430	..	11,858	..	12,027	9	..	1	..	1
Total..........	228,245	..	233,234	..	227,090	587	..	717	..	463

	Home Consumption. 1905. Tons.		1904. Tons.		1903. Tons.
Refined....................................	101,648	..	121,834	..	116,562
Refined (in Bond) in the United Kingdom	80,176	..	77,424	..	—
Raw	13,977	..	18,423	.	81,651
Molasses	16,781	..	14,377	..	11,234
Molasses, manufactured (in Bond) in U.K.	9,523	..	10,376	..	—
Total..................................	222,105	..	242,434	..	209,447
Less Exports of British Refined......................	3,297	..	3,823	..	4,633
Total Home Consumption of Sugar	218,808	..	238,611	..	204,814

Stocks of Sugar in Europe at uneven dates, March 1st to 22nd, compared with previous Years.

In thousands of tons, to the nearest thousand.

Great Britain.	Germany including Hamburg.	France.	Austria.	Holland and Belgium.	Total 1905.
181	931	582	496	134	2324

	1904.	1903.	1902.	1901.
Totals	3195 ..	3031 ..	3181 ..	2490

Twelve Months' Consumption of Sugar in Europe for Three Years, ending February 28th, in thousands of tons.

(Licht's Circular.)

Great Britain.	Germany.	France.	Austria.	Holland, Belgium, &c.	Total 1904-5.	Total 1903-4.	Total 1902-3.
1766	1063	569	475	189	4062	3839	3360

Estimated Crop of Beetroot Sugar on the Continent of Europe for the current Campaign, compared with the actual crop of the three previous Campaigns.

(From Licht's Monthly Circular.)

	1904-1905. Tons.	1903-1904. Tons.	1902-1903. Tons.	1901-1902. Tons.
Germany	1,575,000 ..	1,927,681 ..	1,762,461 ..	2,304,923
Austria	893,000 ..	1,167,959 ..	1,057,692 ..	1,301,549
France	625,000 ..	804,308 ..	833,210 ..	1,123,533
Russia	940,000 ..	1,206,907 ..	1,256,311 ..	1,098,983
Belgium	173,000 ..	203,446 ..	224,090 ..	334,960
Holland	135,000 ..	123,551 ..	102,411 ..	203,172
Other Countries .	340,000 ..	441,116 ..	325,082 ..	393,236
	4,681,000	5,874,968	5,561,257	6,760,356

THE

INTERNATIONAL

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☞ The Editor is not responsible for statements or opinions contained in articles which are signed, or the source of which is named.

NOTES AND COMMENTS.

Hawaii.

An esteemed correspondent in the Hawaiian Islands writes: Sugar conditions for 1904 have been the worst which these Islands have ever experienced. Early in 1903 the now celebrated *Leaf Hopper* made its appearance very generally all over the Islands, and its ravages were most decidedly severe. Not only the Hopper, but other fungus diseases cropped up, and nearly ruined many plantations. The estimated loss in tons of sugar was something like 70,000, and in actual cash over $4,000,000. The result was that, with a few exceptions, everybody lost money, and business generally was in a very critical condition. The advance in the price of sugar will really save these Islands from a very serious financial disaster. The Hopper, though still with us in fairly large numbers, is not doing the same amount of damage as formerly. Numbers of enemies have appeared, or are being introduced by our efficient Entomological Department. Of the latter it may be said a more elaborate or more perfect one does not exist anywhere in the world, and with the scientific skill now employed by our Planters' Association, the time is not far distant when we will have under control the insects which have so menaced our sugar industry.

Though the present crop will not be a large one, prospects for the 1906 crop are very promising. Our 1904 crop, as you may have observed, was only 367,475 short tons, being 70,516 tons less than the 1903 crop. It is further to be observed that the cane grown under irrigation is increasing; for 1904 244,610 short tons were produced by irrigation, and only 122,865 tons were produced without. A large irrigation project is fairly under way in our district; and if brought to a successful issue, will enable us to treble our output which is at present in normal years an average of 15,000 tons. By reclaiming dry and barren lands with irrigation water we alone can develop an output of 15,000 tons, and adjoining plantations can always be sure of a certain and paying crop.

Jamaica—A New Government Laboratory.

A new Government laboratory was built at Hope in 1902, and has since been considerably extended to carry out the work on sugar and rum. It is now fitted with the most modern and up-to-date instruments and apparatus for the carrying on of the proposed experiments. The total cost of the enlargement of the building, including all the apparatus and the distillery, has been £2,000, and the work done reflects the highest credit on the Public Works Department who carried it out. The sterilizing room on an upper floor of the building, has an electric light polariscope, by Schmidt and Haensch, of Berlin. No fees will be charged the planters for tests. The station is also supplying estates with tested Brix Hydrometers; every one of the spindles sent out is provided with a correction table for arriving at the temperature, the tables giving the specific gravity and the total solids per 100 lbs. On a lower floor is a fermenting laboratory fully equipped for the special study of the ferments of rum. There is also in the grounds a small experimental distillery for practical researches in rum manufacture, which is a model of perfection. Acetylene gas is used for lighting purposes, and is proving a great success.

Prohibition Order on Spanish Sugar.

Several thousand tons of sugar having recently been imported into the United Kingdom from Spain, a country which grants bounties, a commotion was caused in sugar circles on the Continent where speculation was rife as to whether our Government was going to shirk its obligations. The matter has, however, been speedily settled by An Order in Council under the Sugar Convention Act, directing that on and after April 3rd all sugar from Spain, including molasses and sugar-sweetened products, should be prohibited to be imported into the United Kingdom.

British Guiana Experimental Work on Sugar Cane.

From the Progress Report by Professor Harrison on the experimental work on sugar canes at the Georgetown Botanical Gardens, for the half-year ending 31st December, 1904, we make the following excerpts :—

Effect of Nitrogen.—Second ratoon canes, which received no nitrogen, gave 17·2 tons of cane per acre; with 200 lbs. sulphate of ammonia the mean yield was 22·0 tons per acre; and with 300-400 lbs. sulphate of ammonia per acre the yield was 28·6 tons per acre. With first ratoons the corresponding yields were 17·0, 21·4, and 27·9 tons per acre. In another field of first ratoons the corresponding yields were 8·4, 14·3, and 22·3 tons per acre. The cane D. 625 maintains a high position, and together with D. 145 and D. 109 is recommended to cane farmers. B. 147 although successful on the small scale, is mentioned as being a comparative failure on the estate scale.

The most interesting point of the report deals with the subject of phosphate manuring. Mr. Harrison shows that under the conditions obtaining at the Botanical Gardens, soils containing ·007% phosphoric anhydride soluble in 1% citric acid do not respond to phosphate manurings, and he suggests that planters would do well to have all their fields examined before applying phosphates. We can assert with confidence that on this point alone the salary of a chemist can easily be recovered on an average sized estate.

Gumming Disease in Sugar Canes.

In the *Centralblatt für Bakteriologie*, 1904, 13, 729, E. F. Smith has published a repetition of the work of Greig Smith on the gumming disease of Australian sugar canes. He finds that the common green cane (Bourbon ?) is easily infected, and that culture media, prepared from these canes, supported growths of the characteristic bacteria *Pseudomonas vascularum*. On the other hand the canes, Louisiana 74 and the common purple cane, were not easily infected, and culture media, prepared from them, were unsuited to the growth of the bacteria. The cane referred to here as Louisiana 74 is certainly the classical seedling D74, which has found its way to Queensland from Demerara *via* Louisiana. The observation of the resistance of these two canes to innoculation is of great interest as affording evidence of fungus resisting power as an inherent property of a specific variety of cane.

In the Bombay Presidency there are said to be 56,000 acres of land under sugar cane cultivation, but not a single factory for making white sugar direct from the cane.

THE PERMANENT COMMISSION AT BRUSSELS.

Bounties arising from a Surtax.

The Report by Sir Henry Bergne of the Sittings of the Permanent Commission in October, 1904 (Commercial No. 1, 1905), after describing the result of the discussions in regard to sugared products and other matters, concludes as follows:—

"*Surtaxes in Non-Contracting States.*

"In the course of this session I thought it well to make formal objection to a practice which tends to become a rule with the Commission, viz., to adjudge that a surtax exceeding 6 fr. in non-contracting States must necessarily be regarded as a bounty, without consideration of the question whether such surtax does, in fact, give rise to advantages of the nature of a bounty or not. The proper rule to be adopted would seem to be that the circumstances in each non-contracting State should be carefully considered, with the view to determining not only if a surtax exists, but also whether such surtax does, in fact, give rise to a bounty.

"This point ought to be carefully examined at the next session of the Commission; and, with this view, I propose to send to the Permanent Bureau, for circulation to the members of the Commission, a memorandum, which may serve as a basis of discussion."

We gather from information in the Continental Press that the Commission, which resumed its sittings on the 6th April, has been fully occupied with this subject. The *Journal des Fabricants de Sucre* gives, as follows, the "motions which figure on the order of the day."

"1. A declaration of the British Delegation concerning the application of the penal clause inscribed in the Convention;

"2. A communication from the British Government concerning the countervailing duties applied with regard to sugars from Bolivia, Greece, Guatemala, Haiti, Honduras, Nicaragua, Paraguay, the Philippine Islands, Portugal and the Portuguese Colonies;

"3. A fresh examination of the decisions of the Commission as to the establishment of countervailing duties, especially as concerns the Argentine Republic, Brazil and the Dominican Republic;

"4. The continuation of the examination of legislations, especially those of Cuba, the United States, Mexico, Porto Rico, Uruquay and Venezuela;

"5. The eventual accession of Switzerland to the Convention of 5th March, 1902, demanded by the Federal Government."

The *Journal* states that "the first two sittings of the Commission were devoted to the statement of modifications which had taken place in the sugar laws of certain countries the imports from which had been struck with countervailing duties.

"This examination had resulted, for certain countries, in a revision of the previous dispositions, and, for others, in a demand for a complementary inquiry in order more clearly to inform the Commission of the real situation."

It would appear from this statement that the Commission has given way in some cases, and in others has consented to postpone the question till October.

So far so good; but the real struggle is evidently left for the next sitting.

Mr. Bonar Law's reply to Mr. Lough, on the 11th April, confirms the statement that the Commission has given way. In fact he says, according to the report in *The Times*, "I am informed that the appeal of this country has been admitted, and that the prohibition will not take effect." The report in the French journal qualifies this and points to a further consideration of the matter.

It seems unfortunate that this irregular procedure of the Commission should have been allowed to go so far as to involve a formal appeal against its decisions. It would have been better, in our opinion, to have protested at the outset against any such construction of the terms of the Convention.

The wording of the various Articles is so clear on the point that it is difficult to understand how there could be two opinions about it. But the Parties to the Convention naturally desire to make the most of their position, and have no friendly feeling towards their cane sugar competitors. That they have no case, however, can be very easily shown.

The first Article of the Convention declares that the contracting Parties undertake to abolish direct and indirect bounties on the production or exportation of sugar, and proceeds to give six definitions of such bounties, one of which is defined to be "the advantages resulting from any surtax higher than that fixed by Article 3."

This is quite distinct. It is not the surtax which constitutes the bounty, but "the advantages resulting from the surtax."

Article 3 limits the surtax for the contracting States to 6 fr. per 100 k. It makes no mention of countries outside the Convention being bound to reduce their surtax to that figure, on pain of being penalized if they fail to do so.

The fourth Article lays down the rules for the levying of a countervailing duty on "sugar from countries which give bounties on production or exportation." In order to deal with the bounty defined, as quoted above, in letter *f* of Article 1, it declares the method by which "the advantages eventually resulting from the surtax" shall be dealt with. Here again the Convention is careful to make it clear that it is not the surtax which is to be countervailed but the advantages resulting from it.

Turning to Article 7, we find the duties of the Permanent Commission defined with equal clearness. They are stated under five

heads, the third one being "To *constater* (that is, to prove, to verify, to establish undeniably, to ascertain, to state, to declare) the existence of bounties in the non-contracting States and to estimate their amount in view of the application of Article 4."

Nothing could be clearer. The action of the Commission has hitherto been in flagrant violation of this most definite instruction. They appear to have seized upon every country having an import duty exceeding 6 fr. per 100 k., or exceeding the excise duty by more than that amount, and to have immediately put it on the black list as a bounty-giving State, calculating the countervailing duty and, as a consequence, insisting that this country shall immediately prohibit the importation of its sugar. In order to make their action the more absurd they even propose that we should prohibit the importation of sugar from countries which produce none.

This is indeed bringing the Sugar Convention into contempt, and may well justify even the confectioners in crying out.

This mischief has, most unfortunately, been done, and we must get out of it in the best way we can. There was no time to be lost. The Convention insists that any appeal against the decisions of the Commission under this head must be made within eight days of the receipt of the notification of such decision. It appears from the Parliamentary Paper, Commercial No. 1 (1905), that the notification was dated 23rd November, and was forwarded to Lord Lansdowne by our Minister at Brussels in a letter dated 26th November. On 2nd December Lord Lansdowne acknowledged the receipt and telegraphed instructions to appeal against the decision. It was a very near thing.

The appeal is against all the decisions except that in regard to Brazil. In a letter dated 22nd December Lord Lansdowne explains why Brazil was excepted. He says:—

" . . . I request that you will inform the Belgian Government that no notice was given in the case of Brazil, for the reason that the circumstances of that country did not so clearly, as in the other cases, preclude the possibility that a bounty could result from the surtax; and, moreover, the information in the possession of His Majesty's Government shows that the system of taxation of sugar in force in Brazil is a highly complicated one, which requires careful study and examination before it is possible to say whether or not it gives rise to advantages of the nature of a bounty on sugar exported from certain provinces.

"The appeal lodged by His Majesty's Government only covered the case of countries in which they are in a position to offer positive evidence that no export bounty does in fact exist.

"The reports of the proceedings of the Permanent Commission do not, in the opinion of His Majesty's Government, establish that the Commissioners had before them evidence sufficient to determine whether or not a bounty arises on the export of sugar from Brazil.

"It appears, however, that by a note from the Brazilian Minister for Foreign Affairs to the Belgian Representative at Rio de Janeiro, the Brazilian Government have requested to be allowed a delay of twelve months for the purpose of furnishing the statistics required by the Commission."

This opens a nice question, but one to which the answer appears conclusive. Brazil was not included in the appeal because it was not absolutely clear that there was no bounty. For the reason we have already given, backed by quotations from the Articles of the Convention, we venture to think that it is for the Commission to prove (*constater*) the existence of the bounty and its amount before it can take any action with regard to enforcing Article 4. The onus of proof rests with the Commission entirely, and, therefore, it would, in our opinion, have been quite proper to include Brazil in the appeal. This is an important point with regard to future action, and we hope that our Government will in all cases insist on actual proof of a bounty before any action can be taken under Article 4.

Sir Henry Bergne has discharged his duties with such skill and discretion that we may feel confident that he will, when out of the present entanglement, successfully establish the true principle on which this matter of the surtax shall be dealt with in the future.

THE SUGAR USERS' JOURNAL.

This excellent and well-printed publication is full of interest to all connected with the sugar trade. The amount of information it collects is wonderful. But unfortunately, in spite of good editing, there seems to be a screw loose somewhere. The writers want the public to believe what is incredible. That, no doubt, is why it is so widely read,—like the late Jules Verne's wonderful tales. He discovered that the public loved the incredible, and he spent his life, with great success, in giving it to them. So it is with party politicians and their organs, of which this new journal is by no means a bad specimen. The more wonderful their assertions the more eagerly are they read and remembered. They, like Jules Verne, have discovered this, and, like him, they work the oracle for all that it is worth. It is a political party gold mine,—a Treasure Island. From it they will sail home with a big majority.

This journal wants people to believe that the Brussels Convention has raised the price of sugar by prohibiting the importation of bounty-fed sugar from Russia and Argentina. They suggest that, in fact, this prohibition has caused a corner in the United Kingdom which has raised the price far above that of the outside world; that it has created an artificial scarcity, a perfect famine, and thus deprived the confectioners of their raw material.

We do not wonder that the man in the street swallows this. He is quite ready to believe in any villany. But is this true? Is there the faintest shadow of a foundation for any such statement? We know that every day, almost every hour, Mincing Lane is buying sugar from Hamburg, from Dunkirk, from Antwerp, from Austria, from Holland, at exactly the same price as that paid by the Continental buyer. How can there be any corner here under those circumstances? We are buying Java sugar in competition with India, Hong Kong, Japan, Australia. We are competing with Canada and the United States for our West Indian sugars. From every quarter of the globe sugar is entering our ports at the world's price. Where is the corner?

"But," they will reply, "you cannot deny that the prohibition limits our supply." We deny it absolutely; it does not deprive us of a single ounce. The world consumes 10,000,000 tons of sugar, and produces enough to supply that quantity. Russia comes into competition with Germany, Austria and France in many countries, and when she manages to sell her sugar in those countries there immediately remains so much more German, Austrian or French sugar for our markets. We always get our share of the world's supply, and that is all we want. Russia gets the world's price for her sugar—no more and no less—and therefore it is a matter of perfect indifference to us whether that sugar comes here, or whether we are supplied with similar sugar from other quarters.

"In any case," they rejoin, "you cannot deny that sugar is much dearer since the Convention." Then they try to make every one believe that the Convention is the cause. Every fact in the history of the sugar market during the last three years proves conclusively that this is an absolutely unfounded statement; but it goes on month after month in the *Sugar Users' Journal*.

Sometimes the world makes a great deal more sugar than it consumes, especially when there are bounties. That is the only reason why we had two million tons more than was wanted in 1902, and why, consequently, the price went down to 6s. The producers did not like this and proceeded to reduce their production, in spite of the fact that their bounties were still going on for another eighteen months. This is what the confectioners call a rise caused by the Convention. The reduced production of course led to a small recovery in value, but neither the one nor the other had any connection with the Convention. They were caused by the excessive stocks and ruinous prices, and those were caused by the bounties. The reduced production, and the consequent rise of 2s., were therefore the result of bounties, not of their abolition two years afterwards.

The reduced production failed to reduce the excessive stocks, and therefore prices languished again. The producer, however, had confidence in an increased consumption, and positively increased his

production in the following year, though he knew he would get no bounty on it. Was this the way that the Convention was going to raise the price of sugar—by increasing production? A new theory in economic science.

The first year of the Convention began with prices at 8s. 6d. to 8s. 9d. In December, 1903, they had fallen to 8s. 4½d.; in January, 1904, to 8s.; in February, to 7s. 10½d. Where was the rise of price which, according to the *Sugar Users*, came with the Convention? The beetroot crop of 1903-4 gave a good yield, and we still had more than enough sugar. The crop of 1904-5 would have given nearly the same quantity, about 5,700,000 tons, but the drought knocked it down to 4,700,000 tons, a clean loss of a million tons. We have seen many big rises in price caused by a much smaller deficiency than that; but in this case we are to believe that the rise came not from the loss of a million tons but from that wicked Convention.

We will go back to the figures, which we left in February, 1904, when the price stood at 7s. 10½d. six months after the Convention began its work. It was not till the summer was nearly over that we saw any signs of a serious rise. The Cuban crop fell short and gave some confidence to the market in May, when prices advanced from 8s. 6d. to 9s. 2d., but it was not till August that any belief in a short beetroot crop showed itself in market prices. The price for that month averaged 10s. 4½d., a rise which did not indicate any great fear of a scarcity. September only averaged 10s. 9d., and October 11s. But, then, all hope had gone of a rally in the crop, and the monthly average price jumped up to 13s. 6d. in November and 14s. 2d. in December. Where can the *Sugar Users* find any shadow of foundation in these figures for their misleading statements? Clearly the short crop caused the rise; that and that alone could be the explanation.

And why did a short beetroot crop have so much effect on the market?

Because beetroot constitutes the greater part of the total visible sugar production of the world.

And why is that?

Because bounties created an overgrown industry, and prevented the rest of the world's production from expanding, as it would have done under natural conditions.

Then really the rise was caused by the bounties, not by their abolition?

Yes.

The world will now become independent of the weather in the beetroot districts?

Yes, when cane sugar has had time to expand its borders.

Why will not the public understand this?

Because fiction is more exciting than fact.

THE WEST INDIES AND THEIR FUTURE.

Tropical countries of even moderate fertility, if intelligently administered and cultivated, ought to be the most prosperous regions on the globe; the growth of the crops not being suspended by frost as in temperate climates gives the tropical agriculturist an advantage of three to five months out of the twelve, without reckoning the additional assistance derived from a copious rainfall and a high night temperature. Nature is thus bountiful in her gifts to man if only he have the sense to receive them in a proper spirit, and among such countries peculiarly indebted to nature the British West Indian islands are among the richest. During the old war time the islands were immensely prosperous and West Indian heiresses were the pets of society. The prices of sugar in comparison with those now ruling were enormous and the planters under the (perhaps) excusable impression that prices would never go down kept open house and believing pecuniary difficulties to be temporary only, encumbered their estates with jointures for their wives and other charges with a light heart. The unexpected, however, happened, sugar in course of time fell to a tenth of its old value, and the old planters found that they were in many cases unable to meet even the interest of their debts, and many of them were ruined after a long struggle—the final stroke being given by the introduction of the foreign bounty-fed beet sugar. Happily, however, the distress that has prevailed for several years shews signs of passing away, to be succeeded, it is to be hoped, by better times. But if the better times come to stay, the colonists and their rulers must submit to be taught by the mistakes of their forefathers and the acts of their commercial rivals, and must retrieve their position by good government, hard work, honesty, careful cultivation and manufacture, and above all by the strictest economy. If these colonies are to prosper in the future, the Colonial Office and the local rulers will do well to remember that the people are poor, that there are many arrears to make up, and that their duty is to enforce thrift in the administration at all costs, and at the same time to afford to the traders and planters the best scientific information.

The West Indian colonies include British Guiana and British Honduras on the mainland of America, and the islands and groups of islands as follows:—Jamaica, Barbados, the Windward and Leeward Islands, Trinidad and Tobago, and the Bahamas. One great step towards economy would be to unite all these territories into one confederation under a Governor and federal council to administer the business common to all, while the local administration should be confided as at present to administrators or commissioners. Probably Barbados would be the most central spot for the residence of the Governor and Council. No doubt it would be the work of perhaps two years to federate all the West Indian colonies, but a beginning

could be made by the union of Barbados and the Windward and Leeward Islands, which ought not to take much time and which would effect a very considerable saving, while (the first union once effected) the larger colonies could be admitted one by one to the inchoate confederation.

The population slightly exceeds 1,800,000 living under the eight different states previously mentioned, whose Governors' salaries amount to about £28,000 exclusive of their respective staffs, and whose judges and attorneys-general receive about £30,000 also exclusive of staffs, while the local affairs of the separate islands are attended to by commissioners with salaries varying from £200 to £1200 per annum. Now it seems pretty clear that a single Governor, residing say at Barbados as the most central spot, ought to be able to govern the federated West Indian territories at a salary, say, of £5000 a year,* the local work being performed by commissioners. Similarly that the judge and attorney-generalships could be also consolidated and large savings effected by careful arrangement of the circuits, and allowing the assizes to be opened and held by single judges, particularly when it is to be considered that the greater part of the business is about equivalent in quality to that transacted by County Court Judges, Recorders, and Chairmen of Quarter Sessions at home. By slightly enlarging the jurisdiction of the stipendiary magistrates, a good deal of the present judicial work could be disposed of in the summary courts. Indeed, the working of the police courts requires earnest attention in order to keep within bounds the petty oppression of small shopkeepers, small planters, managers, and overseers over the negro labourers. The truck and tommy shop system is very common and wages are not always paid in cash as they should be. There is very little doubt that the riots that took place in Dominica, anent which Sir Robert Hamilton held an enquiry in 1893, and those that occurred soon afterwards in St. Kitts, owed their origin to such causes. To persons well acquainted with the people the selection of experienced men as stipendiary magistrates is indeed of as much, if not of more importance, than that of the superior court judges or the Governors themselves.

In addition to the Governor and Judicature, there should be an Executive Council of eight members, one from each of the federated

* Objection might be taken to the salary of this governor as being too small in comparison with the amounts now paid to the chief West Indian governors, to which it might be answered that Secretaries of State and Puisne Judges in England only receive £5000 per annum each, and that the expenses of living in England are very high in comparison with the West Indies where living is very cheap. Foreign nations do not pay such high salaries as we do for similar work, nor do they think it necessary for officials to entertain in the lavish way that English officials do. So long as the business is properly done, the less spent in the process the better. The inhabitants are nearly all poor, and it is not fair to saddle them with an expensive establishment, which they are powerless to remove under that mockery of representative government called a Crown Colony.

territories, and an Assembly or House of Representatives of 36 members, viz., 13 from Jamaica, one each from the Bahamas and British Honduras, three each from the Windward and Leeward Islands, four from Barbados, five from Trinidad, and six from British Guiana; roughly, this would be about one member to every 50,000 of the population. These representatives should be elected in such manner as the various colonies or states arrange; all the other systems of representation among them should be retained or rejected as they may wish, but we think that any further body of representatives might be dispensed with, and the local government of each colony or state entrusted to an administrator, and the federal council through committees or single members instructed to supervise his conduct if necessary. The Assemblies in the present Crown Colonies, with their elected and nominated members, are practically of little use except to enable the Governors to get rid of responsibility. An administrator (or small benevolent despot), if well chosen and overlooked by a strong Federal Assembly, would have far more influence for good than any colourless Crown Colony Parliament. At present he is in all but the largest islands almost the sole civil and magisterial authority,* and therefore great care should be taken to appoint thoroughly able and experienced men to fulfil such duties.

The Federal Authority should take particular care that the audit and control† departments should be well organised. During the last eight or nine years a good deal of money has been spent in assisting these colonies, some of which has got into the wrong hands, while some has been distributed with too little regard to economy. Objection has also been taken that much personal inconvenience would be caused to the Governor, the Judges, and other officials in travelling from island to island, but this objection is first of all (except as to the Judges) much exaggerated, and in the next place the convenience of the people, and not of the officials, is the chief consideration.

On all the above details the report of Sir Robert Hamilton on an inquiry into the state of Dominica, in 1893, presented to Parliament in 1894, affords much valuable information. It will be observed that he advocates strongly the confederation of the West Indian Colonies under a single Governor, the appointment of an Inspector-General of schools, which would result probably in a uniform system of education, and also an Auditor-General to secure unity of accounts and control.

* A black policeman told the writer that the local administrator was "eberyting" from postmaster to police magistrate (like Pooh Bah), and finished by saying—"Commisner do all dis and mo' and me pull him 'tring."

† The necessity for strict control of all engineers, surveyors, contractors, &c., is self-evident. We have personal knowledge of an engineer-surveyor employed by a local Government who was remunerated by a percentage on the gross amount spent. Surely the State might have had more consideration for the taxpayer than to sanction a bargain where it was the interest of the engineer to spend as large an amount as possible.

It would also be a good thing if a Special Commissioner of weight and standing could be sent out promptly with full power to carry out the necessary arrangements for confederation as suggested above. If the present Ministry should be unable, in view of the existing state of politics, to spare time to introduce a bill upon the subject, it is to be hoped that their successors will not neglect the opportunity.

Such a bill should include provisions to secure a good supply of labour and to keep it when secured by protecting the interests of the working classes by allowing them to form labour unions, by securing them allotments of land (a matter easy of performance except in Barbados), by abolishing the truck and tommy shop system, by regulating usurious contracts and by putting down with severity the practice of Obi or Obeah, otherwise a system of witchcraft and fetishism brought with the slaves from the West Coast of Africa.

In addition also to these measures, the number of Imperial troops should be reduced as much as possible, as the defence of these colonies in war time would rest almost entirely upon the navy. All that is wanted at present would be summed up in a few engineers and artillerymen to see that the necessary forts, &c., are kept in proper repair; with this exception, the West India regiments, volunteers and police ought to be sufficient to secure public order.

Something has been said previously about the prodigious fertility of tropical land, but although this is undoubtedly the case, good husbandry is required to prevent the growth of "bumper" crops of weeds and other useless vegetables. No doubt there are already a good many chemists, botanists, and engineers, but something more than this is wanted, viz., a strong scientific staff, composed of doctors, chemists, botanists, naturalists, geologists, and engineers working together in intelligent co-operation as advisers to the government on the scientific policy to be pursued in the exploitation of the separate territories, so that the resources of each may be developed in the best and fullest manner at the least expense. This policy should take for its objects general sanitation, including especially the prevention or mitigation of disease, the extinction of insect pests (not forgetting mosquitoes); also the general survey of the lands as a preliminary to measures of afforestation, drainage, water storage for irrigation and for water power, windmills, which in addition to water power ought to be able to supply considerable electric energy for use in manufacture of sugar, &c. Such measures likewise by furnishing shade and increasing the volume of springs in combination with irrigation and drainage, ought to increase the fertility of the soil. The acclimatisation of foreign timber, trees, especially camphor, fruits, flowers, cereals, the improvement of useful plants such as the sugar cane, coffee, cocoa, india-rubber, &c., the improvement of the soil, the roads,

railways, harbours, &c., should also form part of the duties of the scientific staff.*

To descend to particulars, *British Guiana* is an enormous country practically composed of the deltas of three or four large rivers with a mountainous hinterland. There is no doubt a large portion of the available land under sugar, but there is besides considerable work for the explorer. What is wanted here is forest preservation in some parts, in others clearing for new plantations, control of the canal and river navigation, and preservation of dykes in the lower lands; in the upper the prevention of floods and storage of water, the promotion and the cultivation of sugar, indiarubber, &c., &c. Protection of the native tribes and indentured labourers is another item; railways, harbours, &c., a third; sanitation, of course, must be a great feature as the climate is not too healthy.

British Honduras would require similar attention on a smaller scale. It would probably be expedient to introduce light railways.

Jamaica.—A fine, mountainous country, on the whole very healthy, although not at present producing much sugar does a very good business in tobacco, fruit, logwood, pimento, &c. There is probably room for improvement in forest planting and the conservation of water. There ought to be plenty of opportunities for the use of electric power on plantations and in manufactures. With railways it is fairly provided, and the colony is on the whole capable of taking care of itself.

Trinidad is much the same as Jamaica, but possessing a large sugar and asphalt trade. It has plenty of wooded tracts, but there is much room for exploitation.

But the larger colonies can run alone, and it is therefore of the interests of the smaller ones that it is here intended to speak at greater length.

The Bahamas are not so favoured by nature as some of the other islands, being chiefly of coral formation. Still, however, there is a good deal of forest land in some of the islands which might be considerably extended by planting. Cocoa palms could also be more extensively planted than at present with a view to a trade in copra. There is also a fair business in fruit, in fishing and sponges. In malarial spots the eucalyptus could be planted with advantage. Sisal, bow-string hemp and other fibres are produced to some extent.

St. Kitts though formerly covered with wood is now very bare of trees, although there is a large extent of land available for the purpose. The summits and water sheds should be planted with

*It is not intended to disparage in any way the Imperial Department of Agriculture for the West Indies. They have without doubt done much valuable work, but what is wanted, and what they cannot by the very nature of their employment possess, is local experience, which can only be acquired on the spot. For this reason, among many others, the Federal Scientific Department is indispensably necessary.

timber trees suited to the soil, while the lower slopes might be devoted to cacao (which requires shade), india rubber, &c. The planting would probably improve the streams, now scanty, and perhaps provide water for irrigation. Windmills, which are few, might also be introduced. The marshy grounds should be planted with eucalyptus. A light railway might also be constructed from Basseterre, the chief town, to Sandy Point.

Nevis, the next island to St. Kitts, requires a similar treatment.

Antigua, though not so well fitted by nature for production of timber as St. Kitts, would be much improved by extensive planting of eucalyptus in the malarious part of the island and of timber in the comparatively small mountainous corner. A railway from St. John's to English Harbour (a port adapted for large vessels) passing near the principal sugar plantations is very desirable.

Barbuda, a low sandy coral island, almost entirely devoted to the raising of stock, offers a good field for the raising of timber.

Montserrat, well known for its lime culture, the healthiest of all the West India islands, is well adapted for the growth of timber, coffee, cocoa, and sugar, and india rubber, and possesses good water power that only needs development.

Dominica, of the smaller islands, is perhaps the least progressive, and yet with the greatest future before it owing to its extraordinary natural resources. Two-thirds of the land is covered with virgin forest and there is abundant water power. What it chiefly wants is a light railway from the sea to the central valleys in order to bring down timber for shipment.

The *Virgin Islands* though small and rocky and producing very little, should, at all events, be surveyed in order to ascertain whether they would pay for further exploitation.

St. Lucia, *St. Vincent*, *Grenada*, and *Tobago*, are all of a like character, being healthy, mountainous and fertile, with plenty of waste land, water power, some timber, and a fair sugar trade. The first and the third have good harbours.

Barbados comparatively level, of coral formation, of extensive sugar production and well-provided with railways, enjoys very considerable prosperity, and is a fair example of what could be made of the other islands under similar circumstances. About the same size as Dominica, though inferior in natural advantages, it carries a population over 180,000, while Dominica has about 28,000 only.

The majority of the islands are mountainous, of volcanic formation, with water power, plenty of waste land with the exception of Antigua, Barbuda, the Virgin Islands, the Bahamas, and Barbados, which are sandy, and of coral formation. The roads are good except in Dominica, Barbuda and the Virgins, but in all the islands, even those unprovided with water power, the north-east trade winds, blowing nine or ten months in the year, could be made by the use of

improved windmills to furnish a large amount of electric power in aid of the water power of springs and mountain torrents already available.

The savings on the administrative, judicial, and military expenditure should, after allowing for the extra cost of the scientific staff, be set aside to meet the interest and sinking fund of capital required for the exploitation of the now neglected portions of these colonies. Planters should bear in mind that although sugar is probably the most remunerative crop, yet it is not advisable to rely solely upon it and the cultivation of what may be called bye products such as coffee, cocoa, indiarubber, gutta-percha, timber, and cabinet woods (of which there are a great many to choose from), cotton and other fibres, such as jute, rhea, sisal, &c., limes, oranges, bananas, pines, and other fruits. Two of the most pressing wants in the world's trade are timber and indiarubber—both of which are rising steadily in price, and both can be produced in the West Indies—it will be some time before the supply of either is likely to overtake the demand. It would also be wise to plant eucalyptus in all malarious spots to mitigate the attendant fevers; to plant cocoa-nut palms along the sea-shore wherever practicable with a view to future trade in "copra"; to acclimatise foreign plants and insects, such as the teak and analogous timber trees, dates, the mulberry and camphor (now very important to the manufacture of celluloid), the silk moth, the wild tussori * silk moth, &c., &c.

It must not be supposed that the funds to be obtained from the savings on the budget would in themselves be sufficient; it would probably be a wise economy to borrow considerable sums to be laid out in afforestation and public works, always suppesing that the outlay were ascertained to be remunerative in actual though not necessarily pecuniary results. If, for instance, the climate and the health of a locality were so considerably improved, or railways and harbours and irrigation and water power were provided so as to attract a considerable population of taxpayers, it would be worth the outlay. It is on these points that the value of the scientific staff above mentioned would be greatly appreciated.

Fiscal tariffs should also be overhauled, all taxes likely to obstruct trade removed, and a uniform system of imposts should be arrangd. The postal facilities should also be improved, the C. O. D. parcel system introduced. The telegraphs should also be attended to, and in cases where islands are not connected with the system, a wireless installation should be effected, or if the cost be too great the heliograph made use of, while post and telegraphs receipts, after allowing for contingencies, should not be treated as revenue but spent in improving the service and lowering the rates.

* A well-known official at the National History Museum in London has reared these moths without difficulty in Wardian cases.

It would often be possible to develop neglected districts by means of forest or mining or railway concessions to companies. The coinage should be improved and made uniform with that of the United Kingdom, and the owners of encumbered estates encouraged to bring them into the market, &c., &c.

In fact, the most fortunate thing that could happen to the tropical colonies would be the advent, not of a minister of the ordinary "party" type, but of a capable business man as colonial secretary, who would throw himself with enthusiasm into their physical and commercial development. "'Twere a consummation devoutly to be wished."

X. Y. Z. LD.

MODERN SUGAR MACHINERY.

(Continued from page 180.)

CANE MILLS (continued).

Before concluding our notes on Cane Crushing Mills we might refer to the important modification of the usual three-roller mill which was introduced about 1883 by Messrs. Thomson and Black, of Campos, Brazil.

With the object of disintegrating the canes to some extent before entering the ordinary mill, they set up in front of it two rollers having deep V shaped grooves cut round them, and so placed that the ridges of one roller came opposite the grooves in the other. These rollers were supported by an extension of the headstocks; the lower one was driven by spur gearing, actuated by the upper roller of the mill proper, and the upper preparing roller was driven off the lower one by pinions in the usual way.

These preparatory or splitting rollers were found to improve immensely the efficiency of the mill, the deep grooving on their surfaces and their being placed so as to mesh into each other, enhanced enormously their grip on the canes, and a steady continuous feed was the result. The canes issued from these grooved rollers as a mashed and tangled web which passed unbroken into, and between the three ordinary rollers quite automatically, and being already deprived of about 50% of its moisture, it readily gave up a large proportion of the remaining juice, so that the total extraction of such a mill has often on trials exceeded 75% of the weight of the canes, and a usual result is 72% to 73%.

Of these cane crushers perhaps the best known type is the Krajewski Crusher, first made in America and now manufactured by sugar machinery engineers in all parts of the world. The outstanding features of this apparatus are two solid steel rolls secured upon suitable shafts, the surface of the rolls being covered by deep zigzag teeth

so arranged that whilst the teeth of one roll meshes with the space of the other they do not touch. But the fact must be recorded that at least one British firm have a design of their own which is embodied in their five roller mill (*Fig. 1*). This type of mill, made by Messrs. John McNeil & Co., Glasgow, has been introduced into almost every cane sugar country in the world. It is designed with a view to giving high efficiency and durability; and is made adjustable for operating on different kinds and quantities of cane. The splitting rollers are now carried by housings of cast steel, with adjusting screws conveniently placed on top to regulate the space between the rollers; the housings are supported partly on prepared seats on the mill head-stocks and partly on massive columns carried by an extension of the

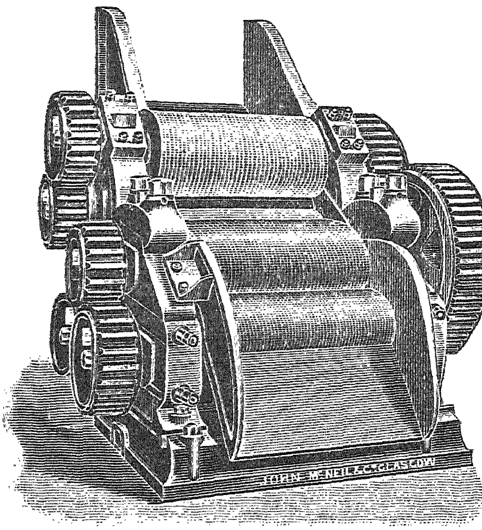
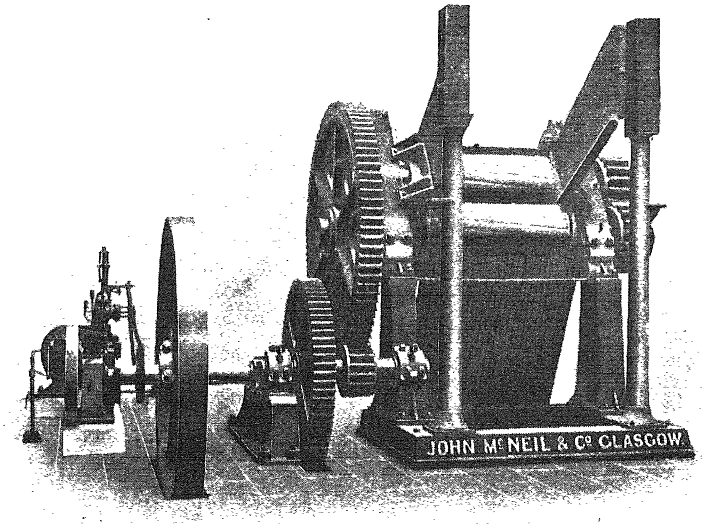


FIG. 1.

mill bedplate. The patented design permits of attaining the minimum distance between the splitting and crushing rollers, so that the mat of canes leaving the former and leading into the latter scarcely touches the intermediate feeding table, but hangs in a curve between the two points of support, and there is no possibility of this mat banking up in front of the top and cane rollers, because of the special arrangements made to obviate this. In this way the working of a five-roller mill involves no additional care on the part of the attendants, but rather the reverse, because of the improved regularity with which the mill takes its feed of canes by the biting action of the splitting rollers, and the half-crushed condition of the canes as they enter the mill proper. The extraction of juice is claimed to be quite as good as from



McNEIL'S PATENT CRUSHER, WITH SEPARATE ENGINE.

double crushing by two ordinary three-roller mills without maceration, while the cost of the outfit is only about two-thirds of the double mills, double engines and gearings and intermediate conductors, and obviously the space occupied by the five roller mill is very much less.

Splitting rollers have been added to existing three roller mills with the best results in numerous instances; in some cases the engine which formerly drove the three rollers was found to work more smoothly when driving all the five rollers, while the quantity crushed and the extraction obtained was considerably increased. In other cases, where the existing engine was considered unequal to the work of the five rollers, an independent engine and gearing were supplied to drive the splitters and the cane carrier.

As an indication of how these mills are appreciated we may mention that Messrs. McNeil supplied, three years ago, the first five-roller mill introduced into Jamaica, and already they are constructing the fifth of the same type for that island. A mill of this type was supplied two years ago to Antigua, and in Barbados the first five-roller mill yet installed there is now at work on its first crop and has been most favourably reported upon.

Multiple Effect Evaporators.

Turning now to Multiple Effect Evaporators, the diagramatic sketch (*Fig. 2*) shows a remarkable quadruple effect evaporator made by The Mirrlees Watson Co. The juice from the mill passes first through a heater between the condenser and the last vessel of the series, then through heaters between each of the other vessels, gradually abstracting a portion of the heat from the vapours as they pass from vessel to vessel, and finally enters a large heater which receives its steam from the first vessel, and passing on to the cleaning pans the juice is there treated and returned to the bottom of the first vessel, where, after passing through a distributing pipe, it rises up through the tubes of the heating surface and loses a certain amount of its water by evaporation, then passing through a trap which permits the passage of the juice and prevents that of the vapour, it enters the bottom of the second vessel, and so on until it leaves the last vessel as dense syrup.

Exhaust steam from the main service of the Factory enters the calandria of the first vessel, and from the boiling juice in this vessel a portion of the vapour is led in the usual way to that of the second vessel; another portion is passed to the juice heater, and a further portion is used for heating the maceration water. The vapour rising from the boiling juice in the second vessel is divided into two portions, part passing through a heater to the third vessel, and a part going on to the vacuum pan.

With this arrangement an evaporation of 6 lbs, per square foot of heating surface has been obtained as a quadruple effect, and this, so far as we know, has never been excelled by any similar apparatus.

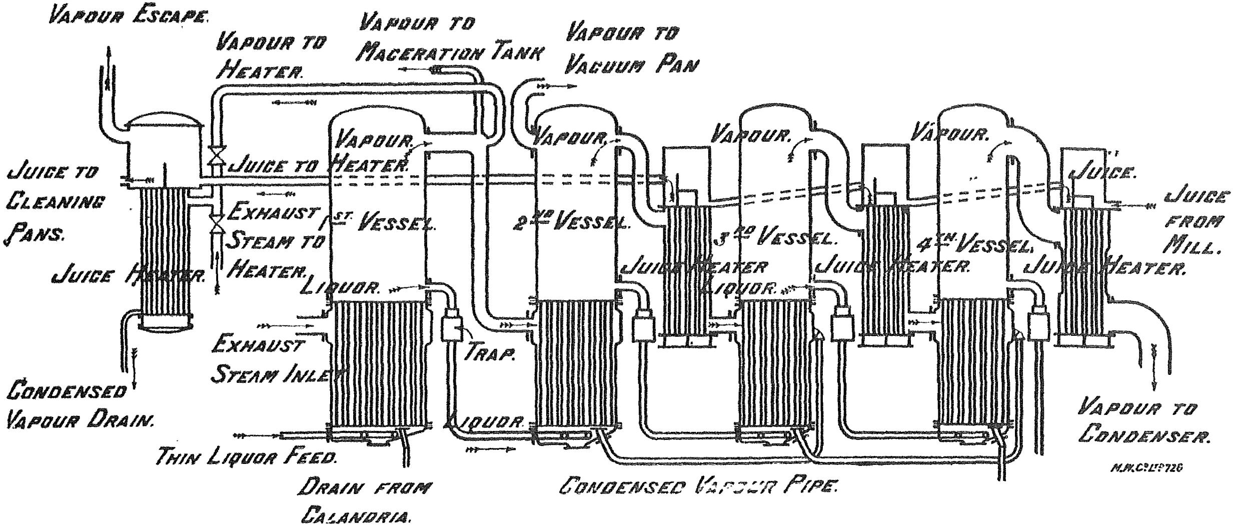

Vapour Escape.
Vapour to Heater.
Vapour to Maceration Tank
Vapour to Vacuum Pan
Juice to Cleaning Pans.
Juice Heater.
Juice to Heater.
Exhaust Steam to Heater.
Vapour.
1st. Vessel.
Liquor.
Exhaust Steam Inlet
Trap.
Condensed Vapour Drain.
Thin Liquor Feed.
Drain from Calandria.
Vapour.
2nd Vessel.
Liquor.
Juice Heater
Vapour.
3rd Vessel.
Liquor.
Juice Heater.
Vapour.
4th Vessel.
Juice Heater.
Juice.
Juice from Mill.
Vapour to Condenser.
Condensed Vapour Pipe.

Fig. 2.

It will be seen at a glance that it is an extremely economical heat using machine. Owing to the proportions of the tubes in the calandrias of this type of apparatus it has been found possible to remove the calandrias of existing multiple effects of the usual design, *i.e.*, with a large down circulating tube, and by substituting calandrias such as are shown on the diagram, a very considerable increase of surface has been obtained at the minimum of cost, thus enabling the proprietors of estates to utilise the largest part of their evaporators and increase the capacity of their factories at minimum expense.

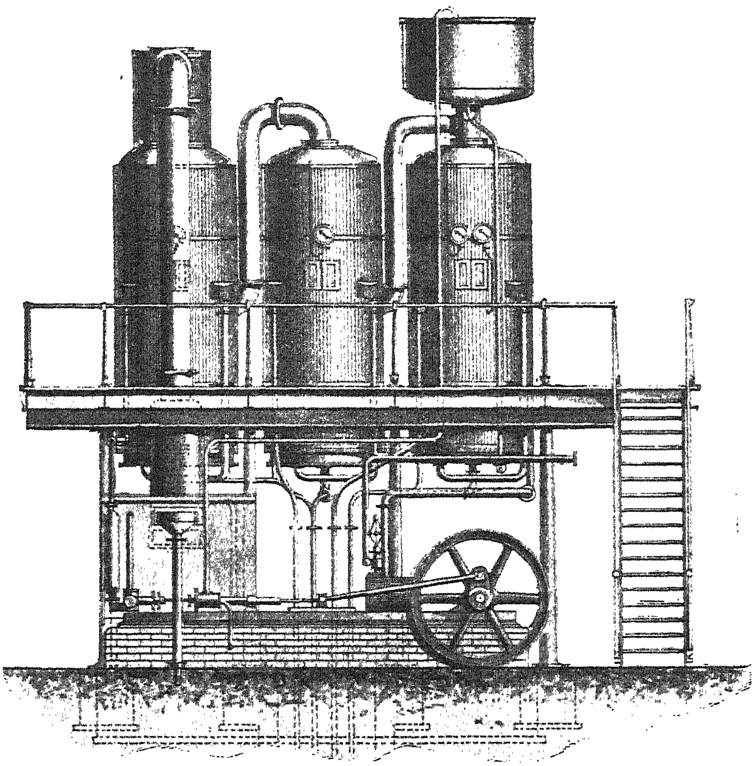


Fig. 3.

In *Fig. 3* is shown a sketch of a Chapman's Multiple Effect Evaporator, made by Messrs. Fawcett, Preston & Co., Liverpool. The circulation of the juice and steam is accomplished by means of the Chapman system of patent circulators, which attain a very high

evaporative efficiency from the heating surface. The bodies, crowns and upper tube plates are made of mild steel; the bottoms and bottom tube plates of cast-iron. The vertical heating tubes are of solid drawn brass. The mountings include thalpotasimeters and a continuous, self-acting syrup testing vessel on the last pan. The advantages claimed for this type of evaporator are: simplicity of management, as there are only two valves to be adjusted; economy of fuel; facility of cleaning; facility of adjustment to meet any variation in the steam pressure. Apparatuses working in numerous countries have been converted to this system with success.

(To be continued.)

THE BEETROOT AND THE SUGAR CANE.

By Th. Dufau.

In the *Journal des Fabricants de Sucre* for January 11th, there appeared a resumé of a paper* by Dr. E. O. von Lippmann dealing with the claims of the sugar cane as a formidable competitor of the German beet industry. Since threats of retaliation from the British Government have compelled the large beet producing countries to abandon their system of bounties in order to dispose of their surplus production on English markets, the two rival saccharine plants now compete under conditions which have not ceased to occupy the attention of the principal fabricants in Germany and Austria-Hungary. These countries, being obliged to maintain an outlet for their surplus production, have had to determine whether the net cost of producing beet sugar is lower than, equal to, or higher than that of cane sugar, supposing fiscal conditions to be similar in both cases. The principles of international legislation being opposed to party interests, whether resulting from the direct intervention of the State, or to understandings between private individuals, it is important to know which of these two sugars can be produced at the lowest cost. The reply to this question may already be deduced from the fact that, whilst legislation has artificially encouraged the production of beet sugar in excess of the normal demands, thus giving rise to a succession of crises by excessive depression of prices, the culture of the cane has continued and even progressed in the absence of any similar protection if we disregard Louisiana, Hawaii, and the French Colonies. In spite of sugar bounties, we have observed a steady increase in the export of sugar from Cuba, save during the sustained war with the United States, and the erection of many new factories in Java. The English Colonies have been able to maintain their production nearly constant, notwithstanding particular difficulties and their distance from their markets.

* A translation of this appeared in our last issue.

Having visited these Colonies, notably Trinidad and British Guiana, in the course of an official mission with which I was charged, I sought to discover the causes which enabled the cane industry to continue the fight in the absence of all favours. Being unable to furnish detailed explanations on this subject in the present communication, I must be satisfied by briefly showing how, and in what measure, the cost of production has been reduced in order to meet the fall in prices. By way of examples, I shall cite two large usines:—Diamond Estate, in British Guiana, producing a minimum of 100,000 bags; and the Usine Ste Madeleine, in Trinidad, producing 150,000 bags, both of which turn out dark crystals for the refineries in the United States. The cost of production at "Diamond," which reached 50 frs. per bag before the first crisis of 1884, has been successively lowered during subsequent years, so that the average figure for 1897-1902 is about 23 frs. At the Usine Ste Madeleine, a similar reduction is apparent; from 45 frs. before 1884 to 22·50 frs. in recent years. Other important usines show similar differences, the present cost of production being 24·78 frs. at Lothians; 23·82 frs. at Caroni; 21·61 frs. at Brechin Castle; 23·02 frs. at Palmiste. So that, speaking of these two Colonies generally, it would be no exaggeration to say that the survival of the sugar industry is due to a reduced cost of production amounting to not less than 20 frs. per 100 kilos.

How has this been achieved? Is it due to improved methods of cultivation, the discovery of a richer cane, or methods of extraction and purification which give higher yields? The answer must be in the negative, and, without wishing to call in question the progress realised in the more modern factories from the point of view of equipment or chemical control, the cane industry can show nothing resembling the progress of the beetroot with its sugar content of 5% increased to 12% or even more; a progress which, in conjunction with bounties, has been the determining factor in the uninterrupted fall of prices from 1884 to 1904. The perusal of the returns of cane sugar factories is, in this respect, very instructive. During these twenty years no appreciable progress has been made capable of influencing the cost of production. The manufacturing returns has fluctuated within the limits of 7½ and 10%, according to the equipment of the factory, the quality of the sugar made or the more or less favourable crop seasons. A short crop is frequently accounted for by the deterioration of the cane brought about by parasitic diseases, or by insufficient manuring owing to the effort to reduce expenses. From the latter point of view, the diffusion process, adopted some years ago in the three usines in British Guiana, has proved a deception, the increased yield being insufficient to cover the higher working expenses, and, more especially, the additional fuel required. These usines have therefore returned to the older process of double and triple crushing.

We must look elsewhere for an explanation of the reduced cost of production. As regards manufacture, economic working must be mainly attributed to the use of machinery and apparatus which dispense with manual labour, and to the almost complete elimination of a fuel account since the installation of improved types of furnaces in conjunction with the Climax and Stirling water-tube boilers, resulting in the production of steam by the combustion of megass alone.

The cultivation, on the other hand, remains empirical, and, notwithstanding the numerous and interesting studies on the propagation of seedling canes at the Botanic Gardens in British Guiana and Barbados, the Bourbon cane, so long acclimatised in the West Indies, has not yet been replaced by any new variety yielding better results on all kinds of soil.

Further economy has been effected by reducing wages and the price paid for canes. In Guadeloupe and Martinique, a day's wage for field-work has been reduced to one franc. In Trinidad and Guiana, where Indian immigrant labour is engaged under a contract specifying a minimum wage of a shilling, or 1·25 frs. per day, the planters have sought to so increase the daily tasks prescribed for in the ordinance, that the physically weaker immigrants are obliged to complete one day's task on the following day in order to secure their nominal wage.

Owing to the nature of the soil in British Guiana, there are very few cane farmers or small proprietors who supply canes to the factories under contracts. On the other hand, cane farming plays a more and more important rôle in the supply of the usines in Trinidad. According to statistics supplied by Prof. Carmody, for the total production of 46,000 tons of sugar in Trinidad in 1900, 364,000 tons of cane were furnished by the estates connected with the factories, and 106,000 tons were supplied by farmers. Here we find a reduction as in the case of wages, the price agreed to having been reduced year by year. During the crisis in 1902, the farmer only received from seven to eight shillings (from 8·75 to 10 frs.), per ton of cane delivered at the factory scale. This allowed very little margin for profit, especially for those who carted their canes over long distances. But, according to the report of the President of the Cane Farming Association, this movement will undergo enormous development in the newly opened-up districts if the farmers are promised a minimum price of ten shillings (12·50 frs.), and if railway communications are extended. The proprietors of Palmiste Estate have resolutely held to this view, even during critical periods and low prices, and have fully availed themselves of the co-operation of cane farmers, who receive advances on their crops. Of 28,000 metric tons of canes ground at this usine in 1896, 23,000 metric tons were grown on the estate lands, and 5,000 metric tons were supplied to the factory by farmers. In 1901,

these proportions were reversed; 13,000 metric tons of canes being grown on the estate, and 17,000 metric tons being furnished by farmers under contracts.

With proper manuring, the yield of cane may easily reach 40,000 kilos per hectare, as is shown by the following averages:—Usine Ste Madeleine, 44,000 kilos; La Fortune, 51,000 kilos; Brechin Castle, 52,000 kilos; Caroni, 42,000 kilos; Palmiste, 39,000 kilos. Assuming a price of from 12 to 15 frs. per 1,000 kilos, the above yields would represent raw material worth from 480 to 600 frs. per hectare.

The German or French agriculturist is naturally able to compare prices offered for his beets, and, when these fall below a certain point, to determine whether it will pay him to continue the same rotation of crops or to abandon the beetroot in favour of cereals. In most tropical countries devoted to the culture of the cane, this plant cannot be replaced by any other annual, the produce of which will support the cultivator. He has therefore no actual choice in the matter; but in submitting to conditions in which he is placed, he has been much blamed for relying upon a single crop. The difficulties and occasional losses attending the culture of the cane are better than the uncertainty of securing any crop at all. If, by reason of very low prices, the planter is obliged to abandon his cultivation, the land must lie fallow for lack of the necessary capital to attempt the cultivation of coffee, cocoa, &c., which yield no return for several years (five or six years in the case of coffee, and at least eight years in the case of cocoa).

In fact, experience shows that notwithstanding the reduction of wages and of the price at which canes are purchased, no other important new industry has gained a general footing in these colonies. At the height of the crisis, when wages had been reduced to a minimum, or living wage, the supply of canes to the usines was rarely disturbed, and the labourers remained faithful both in the factory and the field. When production declined as in Guadeloupe, this has not been due to the shortcomings of the labourer but to the closing of certain usines and to the suppression of the immigrant which has rendered manual labour scarce.

Such has been the situation during the intense crisis which is now drawing to a close. The cane sugar industry, by reducing its expenses in the factory and the field, has held its own in spite of hostile circumstances which threatened to ruin it. To-day, it is preparing to reap the fruits of its patience. The abolition of bounties, which cannot be revived with the approval of the State, has considerably benefited the cane industry *by proportionally increasing the net cost of beet sugar*, making due allowance for the present rise in prices owing to particular and transitory circumstances.

A brighter future is yet in store for the cane industry when the scientific researches pursued at the experimental stations and laboratories of Louisiana, Barbados, Java, and British Guiana shall furnish the planters with varieties of seedling canes, adapted to different soils, and ensuring better returns. On various plantations in British Guiana I have seen seedling canes (such as 625, 109, and 145 D.) which yielded as much as 100,000 kilos or more per hectare. Unfortunately, these seedlings degenerate rapidly owing to causes which are at present unknown, so that it is a matter of serious difficulty to fix the improved characters, acquired and established at the experimental station, when the seedlings are grown on a large scale. There are reasons for hoping, however, that after a long series of tests on purely experimental lines, these difficulties will eventually be overcome, and the cost of production be thereby materially lowered without diminishing the profits of the planter.

Dr. von Lippmann, who sees that the German sugar industry is threatened by these possibilities, thinks that the future extension of the cane industry will be arrested by lack of capital and labour. There is some truth in this opinion, but the difficulties referred to are not insurmountable. Was it not believed that the export of sugar from Cuba would remain stationary owing to the scarcity of labour? Yet the approaching crop is estimated at 1,500,000 tons. There, as in Porto Rico, protection will have the same consequences of over-production, and the prospects of gain attracts labour and capital to these countries. As regards the English Colonies, India remains an inexhaustible source of labour. There are actually 100,000 coolies in Trinidad, and 120,000 in Guiana; these colonies, together with Mauritius, being prepared to increase the number of coolies imported annually, every possible facility was offered them by the home Government acting under the influence of Mr. Chamberlain. The stability created by the Brussels Convention has given confidence to capitalists, and this confidence has been increased since the rise in prices. In Trinidad and Guiana the work of installing up-to-date machinery, of extending railway communications, and of increasing the productive output of the factories is now in full swing.

All things considered, if conditions of absolute equality can be maintained, the increase in the world's production of sugar will henceforth be due to the cane rather than to the beet. Consequently, if the European sugar industry is to maintain the position it has acquired without appealing for protection, it must progress still further and endeavour to secure an increased consumption of sugar by a reduction of the duties.—(From the *Journal des Fabricants de Sucre.*)

A good photo of Professor J. B. Harrison, C.M.G., appears in the *West India Committee's Circular* for April 20th.

RESULTS OF RECENT EXPERIMENTS WITH SEEDLING CANES IN THE WEST INDIES.

British Guiana.

The following paper, on recent progress of Sugar Cane experiments in British Guiana, was prepared by Prof. J. B. Harrison, C.M.G., and read at the West Indian Agricultural Conference last January.

Board of Agriculture Experiments.

(a) *Older Varieties of Sugar Cane.*—Experiments with these have been practically discontinued. The results of fifteen years' continuous experiments showed that, taking the yield of the Bourbon variety as 100, the values of the better kinds were as follows:—

White Transparent	100
Mani	100
Po-a-ole	98·5
Red Ribbon	94·4
Tamarind	84·9
Bois-rouge	81·9
Chigaca	81·2
Kamba-Kamba-vati	80·9
Sacuri	80·0
Purple Transparent	79·4
Elephant	75·7

Few of these varieties are now to be found in the cane fields of this colony. About 1,800 acres are occupied by White Transparent canes, but this area will be largely reduced in the near future. Canes of this variety are also found sparingly scattered through the fields of Bourbon canes. A few acres are occupied by Red Ribbon and Purple Transparent canes grown for experimental purposes, while scattered canes of these varieties may be found in the fields of Bourbon, as a rule more sparingly than are White Transparent. Here and there, a few canes of other varieties may be found, remnants of varieties distributed in the eighties.

None of these varieties on the large scale have equalled in productiveness the Bourbon variety, and every one of them has defects, either from the cultural or the manufacturing point of view, and frequently from both, which effectually prevent them from competing for the planters' favour with the Bourbon as "all-round" canes. The following table shows the number of sugar plantations in British Guiana on which the older varieties are being cultivated and the acreage occupied by them:—

	No. of Plantations.				Acreage.			
	1901-2.	1902-3.	1903-4.	1904-5.	1901-2.	1902-3.	1903-4.	1904-5.
Bourbon	52	51	51	50	67,732	66,191	65,608	59,238
White Transparent ..	24	27	30	28	1,889	2,786	2,876	1,796
Purple Transparent .	3	2	1	Nil	49	35	29	Nil
Red Ribbon	Nil	2	1	1	Ni	24	6	5
Samsara	2	Nil	Nil	Nil	8	Nil	Nil	Nil
					69,678	69,039	68,519	61,039

Total area in sugar cane.	Acres.
1901-2	74,014
1902-3	75,712
1903-4	78,468
1904-5	73,981

(b) *Newer Varieties raised from Seeds.*—As you are all aware our searches for new varieties by means of seminal reproduction and seedling selection are, speaking from the point of view of agricultural time, in their infancy. When the writer made his first visit to Trinidad in 1888, our first seedlings in Barbados were in a stage of very early infancy, and Mr. Bovell and myself hardly ventured to hint that we were guilty of a then scientific heresy; we were—although assured by the highest authorities that the sugar cane never produced fertile seed—growing canes from fallen pieces of cane arrows. Your Trinidad botanist, Mr. Hart, assured me that he saw no reason for doubting that the sugar cane could and did produce fertile seed, and I think that I am safe in stating that he was the first West Indian botanical authority to recognise our new departure and its probable importance.

In British Guiana since 1900 we have raised about one-third of a million tiny canes, and have selected some 26,000 of them for field experiments. Out of these we have selected a few hundred for continued experiments, and from them the planters have selected a very few, certainly not more than fifty varieties, as being possibly of value to them as sugar producers. Out of that fifty some dozen or so show promise of being of actual value agriculturally as producers of sugar.

We have an area of about 35 acres only, available for our own experiments, and hence confine ourselves to preliminary small-scale experiments. Our system of selection is:—

First selection of parent varieties for seed producers.

Second selection of the more vigorous of the seedlings obtained from them for field propagation.

Third selection of the varieties growing under field conditions by the cultural characteristics.

Fourth selection from these selected sorts by their analytical characters.

Fifth selection.—The third and fourth methods are repeated with plants raised from the tops of the varieties selected under the fourth selection, and this is done repeatedly during the cultivation of them from plants to second and third ratoons. As the method of cultivation in British Guiana renders it necessary for canes to have good ratooning powers to be of service as sugar producers, we lay more stress on the selection from ratoons than from plants.

Sixth selection.—These varieties which have been selected are next grown on plots of about $\frac{1}{20}$ acre, side by side and under identical conditions of cultivation and manuring. On these their peculiarities are carefully watched, and out of batches of forty or so selected for this trial probably not more than a dozen will be retained in cultivation as third or fourth ratoons.

Seventh selection.—During the course of the fifth and sixth selections several of the varieties finally retained in cultivation will have been selected by planters by large-scale cultivation. These and a few others selected by ourselves are next examined by means of manurial experiments. Plots of about half an acre are divided into smaller plots, and upon these the varieties are raised under varying systems of manuring. Some of the plots of every kind are manured with phosphates, and perhaps potash, others are not. Some of each are grown without any nitrogenous manures, others with increasing quantities of nitrogen. It has been found that the mean results of a kind under the varying kinds of manuring apparently offer the most reliable figures as to comparative value we can obtain on small-scale experiments.

The following table shows the relative values up to fourth ratoons of the best of the varieties we have submitted to our sixth selection:—

No. of Variety.	Saccharose in expressed Juice per acre of Canes. Tons.	1900-4. Indicated Yields compared with Bourbon as 100.
145	4·80	170·8
625	4·73	168·3
B. 147	4·68	166·5
115	4·54	160·1
109	4·38	155·9
1,087	4·00	142·3
2,468	3·99	142·0
3,157	3·82	135·8
1,896	3·72	132·3
1,640	3·50	124·6
135	3·48	123·8
754	3·15	112·1
White Transparent	3·02	107·5
1,483	3·00	106·7
Bourbon	2·81	100·0

The relative values, as compared with the Bourbon taken as 100; of the yield (in tons of canes per acre) of the canes now in course of the seventh selection on both new and old land are indicated as follows:—

	New Land.		Old Land.
D. 625	220·0	....	162·1
D. 145	157·0	....	182·8
D. 130	150·0	....	—
D. 115	141·5	....	145·7
D. 116	142·6	....	—
D. 109	130·6	....	149·3
D. 78	132·4	....	125·0
D. 3,956	130·0	....	—
D. 74	127·0	....	—
D. 95	117·6	....	—
White Transparent	91·5	....	120·0
Bourbon	100·0	....	100·0
B. 147	88·3	....	—
D. 2,190	58·2	....	—

The Bourbon does not flourish on this land, which is very heavy clay land, and hence the excess yields of many of the other varieties are far higher than will be obtained on the commercial scale.

Until the year 1901 the late Government botanist, Mr. G. S. Jenman, was in direct charge of the work of raising seedlings from seed. He planted seeds irrespective of their parentage and obtained a large number of new kinds. The following shows the results in recent years of this mode of sowing in the percentage of canes obtained which passed the fourth selection as either 1st, 2nd, or 3rd class:—

	Planted in field.	Per cent. of seedling plants which passed.
1896	1,127	4·6
1897	63	9·5
1898	2,452	4·9
1899	2,807	·7
1900	7,760	1·3
Total	14,279	Average.. 2·1 per cent.

In 1901 and since, I have caused a rigorous selection to be taken of the varieties from which seeds are to be made, and the following shows the results:—

	Planted in field.	Per cent. of seedling plants which passed.
1901	4,839	6·3
1902	3,764	1·7
1903	1,407	18·4
Total	10,010	Average.. 6·3 per cent.

Apparently our newer method is the more successful in producing what may be termed the raw material for our researches—new varieties of canes which have passed the 1st cultural and been placed in classes 1 to 3 by the chemical selection.

Experiments on Sugar Estates.

Practically almost every sugar estate in the colony has carried on small-scale experiments with varieties of canes, but as it had been long recognised in British Guiana that the results of small-scale experiments, *and especially of small-scale experiments conducted on sugar estates where it is impossible to give the minute care and attention such experiments require and receive at the experiment station*, are frequently unreliable in their indications for guidance in the selection of varieties for cultivation on the manufacturing scale, no notice is taken of their results except perhaps by the manager of the estate. But we have established a system of large-scale experiments under which only results obtained on areas of not less than one acre and repeated on not less than six estates are recognised. These give more reliable results especially in cases where the area under cultivation is relatively large and the trials are numerous. The following table shows the results of these field trials between 1900 and 1905, giving the mean yields of commercial sugar reported as obtained per acre by each variety during six crops, and the proportion of the yield compared with those of the Bourbon and of the White Transparent taken, respectively, as 100.

	Tons of Commercial Sugar per acre.	Bourbon = 100.	White Transparent = 100.
D. 625	2·50	135·8	150·6
D. 95	2·02	109·7	121·6
Sealy	1·96	106·1	118·0
D. 145	1·95	105·9	117·4
D. 109	1·93	104·3	116·2
B. 147	1·86	101·6	112·0
Bourbon	1·84	100·0	110·8
D. 74	1·72	93·5	103·6
White Transparent	1·66	90·2	100·0
D. 78	1·49	80·9	89·9

Certain estates have not found it feasible to give returns of the yield of each variety, but have supplied comparative returns of the yields of the Bourbon and of seedling varieties. The following are examples of these:—

		Bourbon.			Seedlings.	
	Acreage.	Total Yield.	Tons of Commercial Sugar per acre.	Acreage.	Total Yield.	Tons of Commercial Sugar per acre.
Estate No. 1 (*a*)	703	1588	2·26	151	384	2·55
(*b*)	684	1977	2·89	146	431	2·94
Estate No. 2 (*a*)	1578	3263	2·07	881	2340	2·65
(*b*)	1120	2800	2·50	1001	3180	3·18
Estate No. 3 (*a*)	1494	2347	1·57	793	1448	1·82
(*b*)	956	1280	1·30	1003	1711	1·70

This is an average increase of ·35 tons of sugar per acre or of 17 per cent. in favour of the seedling varieties.

The field and factory results obtained in the large-scale experiments are of high value, as, apart from the actual yields per acre of canes and of commercial sugars, the various difficulties which arise with the new varieties, especially in crushing and in the value of their megass for fuel purposes, are recorded. During the earlier periods of the large-scale experiments it appeared that these difficulties might have proved sufficiently formidable in practice to prevent the adoption of new varieties on the commercial scale, but now they have been largely overcome, and probably in the course of time our planters will succeed either in eliminating them or in obtaining new varieties of canes in which these defects do not occur.

During the crop of September-December, 1904, the areas occupied by the principal varieties reported upon in the large-scale experiments were: D. 625, 174 acres; D. 95, 74 acres; Sealy, 41 acres; D. 145, 105 acres; D. 109, 882 acres; B. 147, 355 acres; Bourbon, 11,900 acres; and White Transparent, 1,725 acres.

I estimate that at present an area of about 14,800 acres is occupied in British Guiana with varieties other than the Bourbon, and of these about 13,000 acres are cultivated in new seedling varieties.

The favourite varieties with our planters are D. 109, B. 147, D. 145, D. 625, and B. 208.

Our experience, as far as it goes, indicates that in the selection of seedling varieties more attention should be given to the size of the cane, the number of shoots each stool produces, and to its ratooning power, which is, in the majority of canes, dependent upon its resistant power to disease and to drought, than to its high saccharine contents. We have found that while the tendency is for decrease in the course of cultivation in the first-named qualities, the sugar contents, in many instances, tend in an opposite direction.

Our experiments with quickly maturing, relatively small-sized canes, such as Nos. 74 and 95, with high saccharine contents have not been altogether satisfactory. A medium to large-sized cane with well-marked tillering and ratooning powers, and of fairly high saccharine content, say, equal to that of the Bourbon, appears to be of higher value to us in British Guiana, than are smaller, relatively rich varieties.

Fortunately, we have indications that among our latest selection of seedlings are large-sized varieties of very high saccharine contents.

Perhaps the advantage of the seedling varieties which is most appreciated by the planters is that several kinds are capable of

yielding large and remunerative crops of canes on land on which the Bourbon will not now thrive. Some varieties will flourish on the heavy clay front lands of the plantations, others on the somewhat lighter soils at the back of the cultivations. On some estates the result of this is that the cane cultivation using seedling varieties is being extended at the back of the estates on soils that the Bourbon cannot flourish upon, while land set free from cane cultivation on the front lands is being planted in rice.

SOME FIGURES RELATING TO JAVA SUGAR MILLS DURING THE SEASON 1904.

We have been favoured with a large sheet containing figures relating to the work at 87 Java sugar mills during 1904. We give below the mean results, believing these will be of interest.

	Cane.				
	Per cent. Sucrose in the Cane.	Per cent. Sucrose indicated in the Juice on 100 Cane.	Available Sugar (Muscovado) $1{\cdot}4 - \frac{40}{\text{Quotient.}}$	Juice extracted on 100 parts of Juice	Per cent. Fibre in the Cane.
Highest ..	15·46	14·36	13·76	93·47	13·07
Lowest ..	10·18	8·85	8·09	86·94	9·82
Mean.. ..	13·06	11·91	12·21	91·33	11·29

	Maceration Water on 100 parts of Normal Juice.	Bagasse.			Filter Press Cakes.	
		Sucrose.	Moisture.	Sucrose lost on 100 parts of Cane.	Sucrose.	Sucrose lost on 100 parts of Cane.
Highest ..	24·89	5·34	51·52	1·46	11·0	0·23
Lowest.. ..	7·42	3·63	41·27	0·88	0·91	0·03
Mean	14·45	4·63	47·15	1·12	7·96	0·09

	First Mill Juice.			Last Mill Juice.	
	Brix.	Sucrose.	Quotient.	Brix.	Quotient.
Highest ..	20·3	18·3	91·55	11·6	86·15
Lowest ..	16·3	12·68	80·1	5·6	72·0
Mean.. ..	18·09	15·64	86·39	8·02	80·07

	Mixed Juice.			Quotient Clarified Juice.	Syrup.	
	Brix.	Sucrose.	Quotient.		Brix.	Quotient.
Highest ..	17·83	15·38	89·89	91·7	64·45	92·21
Lowest	13·8	10·69	78·48	81·27	43·46	81·07
Mean	15·65	13·33	79·31	86·57	53·36	83·17

	Masse-cuite.		Returned Seconds.		Quotient on first Molasses.
	Brix.	Quotient.	Polarization.	Weight on 100 parts of Cane.	
Highest ..	97·4	91·07	98·19	0 94	73·68
Lowest ..	90·09	63·6	67·4	0·01	39·0
Mean.. ..	94·2	72·44	83·38	0·28	49·67

	Sugar.				
	Polarization of Head Sugar.	Polarization of Muscovado.	Polarization of second Boilings.	Head Sugar turned out on 100 Cane.	Muscovado turned out on 100 Cane.
Highest ..	99·68	98·1	99·47	10·90	13·69
Lowest ..	98·3	97·7	77·29	0·01	0·41
Mean.. ..	98·77	97·03	93·54	3·59	9·17

	Sugar—*continued.*				
	Second Boilings turned out on 100 Cane.	Black Stroop turned out on 100 Cane.	Total Sugar turned out (Black Stroop 2 : 1).	Sucrose turned out.	Quotient of Molasses.
Highest ..	3·17	1·65	14·14	13·87	40·7
Lowest ..	0·01	0·10	7·64	7·69	30·8
Mean.. ..	1·02	0·59	10·90	10·76	34·83

One Glasgow firm have during the past three years received orders for as many as seven five-roller sugar cane mills for the West Indies alone. This shows that enterprise and capital are both to be found in those islands now that the sugar bounties are a thing of the past.

MANURIAL EXPERIMENTS IN BRITISH GUINEA.

Prof. J. B. Harrison has recently given (*West Indian Bulletin*, Vol. V., No. 6) a summary of the results derived from 24 years' experimental work in the British Guiana Botanical Gardens. A short abstract of these results of great interest to cane growers is given below:—

Lime.—Alternate beds of heavy clay land were treated with five tons of slaked Barbados lime per acre. The canes were grown up to third ratoons and then fallowed for a year. In the plots which were manured in addition to liming, the total increase due to liming was 37·0 tons of cane per acre, and in the unmanured plots at the rate of 33·7 tons per acre. Both the above increases refer to the sum total of ten crops harvested in 13 years.

Phosphates.—Applications of phosphates have not always resulted in financial benefit. It appears that the most satisfactory mode of using phosphates is to apply 3 cwt. of superphosphate or 5-6 cwt. of slag phosphate to plant canes, the dressings of slag phosphate being more remunerative than those of superphosphate of equal cost. Phosphates do not benefit ratoons and Prof. Harrison thinks it doubtful if it is necessary to apply phosphates to Demerara soils as often as once in five years.

Potash.—Results obtained with both sulphate and nitrate of potash indicate that potash is not required on the heavy clay soils of British Guiana under the conditions of ordinary agricultural practice.

Nitrogen.—As the mean result of ten crops of cane in 13 years it was found that 10 lbs. of nitrogen as sulphate of ammonia, when added in proportions up to 300 lbs. per acre, gave an extra return of 1·3 tons of cane per acre, or 2½ cwt. commercial sugar. With nitrate of soda up to 250 lbs. per acre, 10 lbs. of nitrogen would probably give 1·4 tons of cane, equal to 2½ cwt. of commercial sugar, but experiments indicate that it is not wise to apply more than 250 lbs. nitrate of soda at one dressing. With dried blood the indications over eight crops were that the relative value of nitrogen in this material was 73 % of that in sulphate of ammonia.

With regard to the effect of manures on the soil Prof. Harrison comes to the following conclusions, basing his results on the analytical figures obtained by the extraction of the soil in 1 % aqueous citric acid with five hours' continuous shaking:—

"(1.) That the growth of the sugar cane without nitrogenous manuring is accompanied by a considerable loss of the nitrogen in the soil, amounting in ten years to 18·6 % on not limed land, and to 26·7 %

on limed land. These are equivalent to losses from the soil to a depth of 8 inches of 880lbs. and 1250lbs., respectively, per acre.

"(2.) Repeated heavy dressings with farmyard manure have resulted in an increase in the total nitrogen of the soil. In ten years the increase was 20·3%, equal to 960lbs. of nitrogen per acre added to the soil to a depth of 8 inches.

"(3.) The growth of the sugar cane on plots receiving only nitrogenous manures has resulted in losses of soil nitrogen: where sulphate of ammonia was applied, the loss amounted to 14·7%, or to 670lbs. of nitrogen, and where nitrate of soda was used, to 16·3%, or to 775lbs. of nitrogen per acre, in the soil to a depth of 8 inches.

"(4.) On soils manured with phosphates, potash, and nitrogen in the form of sulphate of ammonia, the loss of soil nitrogen in the top 8 inches amounted to 14·7%, or to 700lbs. per acre, while where nitrate of soda was the source of nitrogen the loss was far higher, amounting to 26·5%, or to 1250lbs. per acre.

"(5.) The soil in 1891, at the commencement of the experiments, yielded ·0142% of phosphoric anhydride to a 1% aqueous solution of citric acid. After ten years cropping without manure it yielded ·0086%, which shows a loss of nearly 40% of the probably available phosphoric anhydride, or of, in round figures, 170lbs. per acre.

"(6.) Where the soil received manures not containing phosphates, the proportion of probably available phosphoric anhydride was reduced to ·0096%, equal to a loss of 32·4%, or to one of, in round figures, 140lbs. per acre.

"(7.) Where superphosphates were used in addition to nitrogenous manures, the proportion of probably available phosphoric anhydride was reduced to ·0132%, indicating a loss of 7%, or of 30lbs. per acre.

"(8.) Where slag-phosphates had been applied, the probably available phosphoric anhydride has been reduced to ·0102%, equal to a loss of 28·1%, or to one of 120lbs. per acre. It is worthy of note that in our more recent experiments, while manuring with slag-phosphates, produced on the plots which had received superphosphates during the earlier years of the experiments, mean increases of only 2·3%, they produced on those which had been manured with slag-phosphates a mean increase of 5·8%.

"(9.) The determinations of potash soluble in 1% citric acid and in 200th normal hydrochloric acid showed that cultural operations have made probably available more potash each year than is required for the growth of the sugar cane, the original samples yielding potash at the rate of 262lbs. and 278lbs. per acre to a depth of eight inches, those not manured with potash salts during ten years at the rates of 376 lbs. and 500 lbs., and those which received potash salts in addition to nitrogenous manures at the rates of 357lbs. and 530lbs.

"(10.) Judging from the solubility of the lime in the soil in 200th normal hydrochloric acid, cultural operations set free in a soluble form more lime than the crops utilised, the original soil yielding lime to the solvent at the rate of, in round figures, 3,400 lbs. per acre to a depth of eight inches, while the samples taken after ten years' cultivation yielded at the rate of 3800 lbs. The soils which received in July, 1891, slacked lime, supplying in round figures, 6700 lbs. lime per acre, yielded to the acid in 1902 a mean of 5000 lbs. per acre, thus indicating after ten years' cultural operations a retention in the uppermost layer of the soil of only 1200 lbs. of the added lime in a readily soluble form.

"(11.) The action of the lime on the solubility of the potash in the uppermost layer of the soil appeared well marked, the samples from the not-limed land yielding to 200th normal hydrochloric acid at a mean rate of 460 lbs. potash per acre to a depth of eight inches, while those from the limed land yielded at the mean rate of 640 lbs."

Finally, as the result of these analyses and experiments, Prof. Harrison lays down certain precise and formal propositions of the greatest value to the agricultural chemist responsible for the economic manuring of large areas of sugar cane. These may be summarised as under:—

(1.) Soils which yield ·007% phosphoric anhydride to 1% aqueous citric acid with five hours' continuous shaking will not as a rule respond to manurings with phosphates.

(2.) Under similar conditions soils yielding ·005%-·007% will benefit as a rule by phosphatic manurings.

(3.) It is advisable to apply heavy dressings of slag-phosphates or lighter ones of super or basic phosphates to soils yielding less than ·005% phosphoric anhydride.

(4.) Soils yielding ·008% potash can be regarded as containing under the usual system of cultivation sufficient available potash for the needs of the sugar cane.

(5.) If the potash lies between ·005% and ·008% it is doubtful if the application of potash salts will result in remunerative returns.

(6.) Where the potash falls below ·005% it is advisable to add potash salts in the manures.

(7.) The demand of the sugar cane for lime as a plant food is low, and if a soil gives up more than ·006% to the 1% citric acid solution, it probably will yield sufficient for plant food for ordinary crops of sugar cane.

ARTIFICIAL CROSS FERTILIZATION.

In his paper on the sugar industry in Barbados, read before the Agricultural Conference last January, Professor d'Albuquerque referred to some attempts at artificial cross fertilization which had been made just recently. He said:—

Artificial Cross Fertilization.

In a paper on this subject in the *West Indian Bulletin* (Vol. I., pp. 185-7) one of us suggested various ways in which an attempt might be made to raise seedlings of which both parents were known, in place of the present methods in which only the mother variety is known with certainty. One suggestion was that the anthers should be removed from the immature flowers of one variety, which should be subsequently protected by a fine muslin bag from wind-borne pollen, and when ripe fertilized by pollen from the flowers of another and known variety.

This experiment has been successfully carried out last November by Mr. Lewton-Brain, Mycologist on the staff of the Imperial Department of Agriculture, who worked with some of the most promising varieties of Barbados seedlings. A very small proportion of the seed germinated, but sufficient to justify a continuation of the experiment next season on a much larger scale.

The method of carrying out this experiment is described by Mr. Lewton-Brain as follows:—

"The attempt, made in November 1904, to raise hybrid sugar-cane seedlings, by artificially cross-pollinating the flowers was undertaken rather with a view to determining whether such a process were practicable, than with the hope of obtaining any present results.

"The experiment was carried out in the experimental field at the Ridge plantation, Christ Church, Barbados. The canes operated on were some of one of the newer seedling varieties B. 1,529 which had given the best results in the previous year's experiments.

"A strong, movable platform was constructed, 8 feet high, the top being 6 feet by 4 feet. On this there were boxes of different sizes, which served as tables and stools of varying height. The stamens were removed under the dissecting microscope, and the chief difficulty was found to be that of keeping the spikelets steady under the lens, while the work was going on.

"Arrows which were just beginning to emerge from the upper leaf-sheath were always selected. The cane was bent over carefully to the table and tied firmly to neighbouring canes and to the platform. The lower part of the arrow was placed in a clamp, the foot of which was then screwed into the top of the platform. All this had, of course, to be done with the greatest care, so that no undue strain was put upon any part of the cane.

"The table and dissecting microscope were then shifted into as convenient a position as possible, and the stamens were removed from about a dozen to twenty spikelets, preferably on several branches of the arrow. This operation proved to be one of some difficulty and delicacy under field conditions; frequently the stigmatic plumes were removed or injured before the third stamen could be got out. It was found necessary to work with one's back to the sun to avoid the glitter from the glumes and hairs.

"The remaining spikelets on the arrow, including, of course, all those that had emerged into the air before the operation, were then removed.

"Meanwhile a strong pole, 10 feet high from the ground, had been fixed near the base of the cane. To this, near the top, was fixed a wire cage sufficiently large to include easily the whole arrow, the cage was made in two halves which were left sufficiently apart to admit the arrow. The cane was now gently and gradually released, and the arrow brought into the cage: this was then closed and covered with fine, strong muslin. The whole was sewn up carefully, and the cane and arrow tied up to the pole; in some cases too great strain was put upon the upper part of the cane in the tying, and the arrow dried up. A few days later, when the stigmatic plumes were seen to be turning red and opening out, pollination was performed, and the muslin again sewn up.

"The whole process is tedious and one that requires great care and delicacy at every point. Under the conditions this is not always easy. Even then a sudden gust of wind or a sudden shower of rain may spoil a morning's work.

"The result has been that four seeds germinated. Considering that normally the percentage of germination among sugar-cane seeds is extremely low, this may be considered fairly satisfactory. At any rate it is proved that the raising of hybrid sugar-canes by artificial cross-fertilization is not impossible, but it is also evident that, to get sufficient seedlings to work with and select from, experiments must be carried out on a much larger scale than was the present one.

"At the same time that the above work was in process, other arrows were enclosed in similar fashion without emasculation. When the spikelets were opening other arrows from the same variety of cane were introduced into the bags for their pollination. A number of seedlings have been raised from them, and these will be the first seedlings canes raised in the West Indies whose parentage is a matter of certainty."

The authors of this summary regard the results of this attempt as affording important means of accelerating the work with seedling canes, since it is thereby possible to ensure that the parents of the seedlings are both varieties of known and favourable characters.

Correspondence.

MAURITIUS.

A Plea for Social Reform.

To the Editor of "The International Sugar Journal."

Sir,—In answer to the letter of Mr. Ulcoq of the 16th March, who repels with rather unnecessary indignation my "sweeping charges," I have much pleasure in answering them seriatim, and in assuring him that I wrote from my own observation in perfect good faith and that I am as anxious to secure the true welfare of the Island as Mr. Ulcoq himself. As to land drainage, water storage and forestry, I simply said that much was required to be done, and am told in reply that a little, a very little, has been done and that the badness of the water in places is due to the "inexorable climate of the tropics," whatever that phrase may mean.

The devotion of the inhabitants to the King is outside the question. All British subjects are supposed to be loyal and to pray for the monarch and his family. The reference to Lady Broome's work falls into the same category. I have not read it, but do not doubt that she did her best (as I have done) to describe faithfully what she saw and heard at the time of her residence, but she wrote some time ago, and we are concerned with the present and not with the past; the Cernean creoles may as a body have degenerated or improved since then. Whether I moved in the upper circles of the local society or not does not concern Mr. Ulcoq. No one doubts that the educated classes in the Island speak good English and good French, but the fact remains the same that the current tongue is Creole-French, and that in nearly every French paper published in Mauritius articles written in that dialect are habitually inserted. Nor does anyone doubt that public instruction is given, nor that some of the native students preparing for the public service and the professions do distinguish themselves, nor that some of them have entered the public service and have attracted the notice of Governor Boyle.

Mr. Ulcoq has evaded the question as to whether the planters did or did not apply to the Government for assistance when the Arabs cornered the market. This is the real point to be answered. And he has made a similar evasion as regards the "sura" loan. Did they, the planters, apply for a postponement of the first instalment of the interest, and did they some six months afterwards apply for a further postponement? Mr. Ulcoq might direct his attention to this item also, and enquire at the same time whether it was not well known

that the sugar bounties would be removed before the latter postponement (at all events) was asked for.

As to the case of the Mayor of Port Louis, Mr. Ulcoq has put his own gloss on the facts while in effect admitting them. The Mayor insisted on carrying out his views against the opinion of a majority of the Committee, who pointed out that he was acting in contravention of an existing ordinance, and their opinion was upheld by the Courts. The facts and the findings of the Courts were published in the local newspapers from which among other sources I derived my information.

Neither does he see fit to break his judicious silence as to the low physique and perhaps consequent lazy and slovenly habits of many of the tradesmen and artisans, nor as to the heavily encumbered landed properties, but contents himself with a remark about the ousting of planters by foreign capitalists, and carefully forgets that if they managed their estates judiciously there would be no opening at all for the money lender, native or foreign, though probably to the Cernean debtor it would be a matter of indifference whether his creditor was Israelite, Ishmaelite, or Gentile.

In effect Mr. Ulcoq either fails or does not wish to understand that my attack is limited to the inept and corrupt of which the Creole population contains an abnormal proportion, and that as to the able and upright section, the worst I would say or do is to wish that they were more numerous. If Mr. Ulcoq is a member of the latter I trust he will accept my assurance that I have not the slightest wish to speak of him in any but the highest terms, but if he chooses to identify himself with the defenders of laziness, abuses, &c., &c., he must expect to hear some rather plain language. It will also rest with him to explain away, if he can, the reasons which induced the Home Government to appoint a strong man like Sir Courtenay Boyle to undertake the task of reform. I was in the Island and had collected the materials for the obnoxious article before the arrival of the present Governor, but hardly expected that he would have settled down to the work of re-organisation so promptly and effectively as he has done. I state for Mr. Ulcoq's benefit that the Governor, who is, I have reason to believe, supported by the best and most patriotic of the Mauritians, has by his action entirely justified my article.

I remain, Sir,

Your obedient servant,

The Writer of the Article.

MONTHLY LIST OF PATENTS.

Communicated by Mr. W. P. Thompson, C.E., F.C.S., M.I.M.E., Chartered Patent Agent, 6, Lord Street, Liverpool; and 322, High Holborn, London.

ENGLISH.—ABRIDGMENTS.

8544. C. P. Cross, London. *Improved manufacture of a crystalline sugar from a form of cellulose.* 13th April, 1904. This invention relates to the manufacture of a crystalline sugar by hydrolysing a form of celluloso or hemi-cellulose characterised by its short cellular structure and by the ease with which it undergoes this hydrolysis.

9355. F. Holl, Worms, Germany. *Apparatus for cooling and drying granular materials, such as moist sugar and the like.* 23rd April, 1904. This invention relates to an apparatus for cooling and drying granular materials, such as moist sugar and the like. The apparatus is constructed in such a manner that the material is first passed through a sifting drum, and then traverses the apparatus from top to bottom, zigzag, being continuously exposed to a current of fresh air.

26255. A. Neumann and G. Stade, both of Berlin, Germany. *Improvements in and relating to vacuum apparatus for concentrating and evaporating liquids.* 2nd December, 1904. This invention relates to vacuum pans of that kind in which the heating apparatus is situated in the interior of the pan and in which use is made of the buoyancy imparted to the liquid to be boiled by heat and evaporation, for the purpose of producing and maintaining a continuous forced circulation.

28534. A. Horn, Hackney Wick, Middlesex. *New or improved machine for pulling and doubling boiled sugar in a semi-fluid state.* 28th December, 1904. This invention relates to a machine for pulling and doubling boiled sugar in a semi-fluid or plastic condition, in which the mass of sugar is rotated on a horizontal rotating disc and subjected to pulling and doubling actions by pins or hooks mounted on the said disc and acting in conjunction with other pins or hooks mounted on a double arm rotated by a vertical spindle.

28620. P. Haase, Herzogtum Sachsen-Meiningen, Germany. *Improvements in and relating to machines for separating dust from sugar goods.* 28th December, 1904. The present invention relates to a machine for freeing sugar goods from their fine dust, and consists in the actuation of a tray, furnished with brushes, by means of an endless belt driven in an irregular manner so that the sugar goods, which are laid upon the tray, are freed from dust by the operation of a set of brushes pivotally mounted upon the respective sides of the machine frame, and actuated by an eccentric so as to have an up and down motion, whereby they alternately fall upon the tray and rise above it; the dust separated by this operation being carried away by a current of air supplied by a fan or other means.

GERMAN.—ABRIDGMENTS.

156858. MARTIN HOCKER MILLER, DAVID HUETHER, Dr. ARTHUR HAMILTON HOUGH, ALEXANDER MCNEILL, and Dr. RICHARD FISHER, of Wiarton, Canada. *Apparatus for electrolytic purification of saccharine juices.* June 26th, 1903. This apparatus consists of a vessel open in the centre and divided into two parts by a porous cylinder and provided in the outer annular space with cylindrical electrodes immersed in water, and its characteristic feature is that a feed-pipe for the juice is carried up nearly to the top of the vessel and bears at its upper end a mushroom-shaped over-flow and beneath this several superimposed umbrella-shaped electrodes formed of wire netting or perforated sheet metal, these latter being adjustably mounted and bringing the juice into thorough contact with the air.

157090. THE FIRM OF E. BENDEL, of Magdeburg-Sudenburg. *A method of drying or cooling granulated sugar.* November 21st, 1902. This method of drying or cooling granulated sugar consists in the sugar grains being allowed to fall freely against a rising hot or cold air current in apparatus having vertical cylinders, any contact with the walls of the apparatus being preferably prevented by making the inlet aperture smaller than the interior of the cylinder.

157254. ASKAN MÜLLER, of Hohenau, Lower Austria. *A process and apparatus for casing sugar in centrifugals.* 27th January, 1904. In this process of casing sugar in centrifugals in order to facilitate the escape of the syrup at the commencement of the casing, a portion of the cold air contained in the interior of the centrifugal casing is drawn off by means of an injector nozzle located underneath the cover, and mixed with superheated casing steam for the purpose of producing a moist vapour free from drops. The apparatus for carrying out this process consists of a centrifugal in which a water separator, arranged on the centrifugal cover, is provided, having tangential pipes opening into the centrifugal for introducing steam and carrying off water of condensation, the casing steam being introduced by a pipe projecting partly into the water separator and partly into the centrifugal drum, which pipe is surrounded by a sleeve or sheath provided with apertures for drawing off the air contained in the centrifugals.

157375. THE FEDERAL REFINING COMPANY, of Jersey City, New Jersey, U.S.A. *A method of purifying sugar in solid or fluid form.* April 9th, 1904. This invention relates to a method of purifying sugar in solid or liquid form, and consists in treating sugar with a liquid produced by the action of sulphuric acid, or a mixture of acids, on resin, resinous oils, ethereal oils, grease, fatty oils, oleic acid and the like, freed from sulphuric acid, and substantially consisting of sulpho-compounds and sulpho-oleates, and then separating out this liquid in any suitable manner.

157377. THE FEDERAL REFINING COMPANY, of Jersey City, New Jersey, U.S.A. *A method for separating a purifying liquid containing*

sulpho-compounds and the like from sugar solutions. April 9th, 1902. This method of separating a purifying fluid containing sulpho-compounds and the like from sugar solutions, consists in adding to the mixture of sugar solution and purifying fluid a substance which converts the latter into a solid condition and then separating by filtration the purified sugar solution from the purifying fluid which has thus become insoluble.

157701. HEINE BROTHERS, of Viersen, Rhine Province. *A method of relieving the shaft bearing in centrifugals.* January 26th, 1904. This method of relieving the shaft bearings of centrifugals and reducing the vibrations produced by oscillations of the drum, consists in the casing surrounding the rotating drum being filled with liquid, so that the latter when the drum rotates, forms an elastic cushion bearing against it.

157907. ARTHUR EITNER, of Leipzig-Schleussig. *A shreddings press having a cylindrical complete worm on a cylindrical spindle.* 13th June, 1903. This invention relates to a beetroot shreddings press provided with a cylindrical complete worm on a cylindrical spindle, and having a compression chamber between the worm and the mouthpiece of the press, which chamber tapers downwards and is provided with smooth separating walls.

157926. WILHELM GANTENBERG, of Ketzin, Brandenburg. *Method of and apparatus for separating the drain according to its constitution inside the centrifugal.* 2nd June, 1904. This method of separating the drain according to its constitution inside the centrifugal, consists in providing a second straining drum between the actual centrifugal drum and the drum casing, which second drum periodically rotates with the actual centrifugal drum, so that the drain thrown off from the inner drum passes through the outer straining drum, whilst the stationary outer straining drum allows the drain to trickle down its inner wall and correspondingly reach different gutters. In the apparatus for carrying out this method of separating the drain according to its constitution the bottom of the outer straining drum is provided with peripheral escape apertures and is formed in its central part as a hollow cone which may be brought periodically into and out of engagement with the cone of the centrifugal shaft by means of a suitable lifting apparatus.

157672. LUDWIG LORENZ, of Dormagen. *A knife for beetroot shredding machines.* 9th March, 1904. This knife for beetroot shredding machines is formed of separate curved pieces of sheet-metal or of one piece of filed corrugated plate, suitably shaped core pieces being further inserted in the spaces beneath the cutting edge of the knife, so that a direction adapted to cause the shreddings to fall out of the cutter is given to these shreddings by reason of the profile of the knife.

158275. ALB. FESCA & CO., Maschinenfabrik & Eisengiesserei Akt.-Ges., of Berlin. *A drain separating device in centrifugals for*

syrups and other fluids. 14th May, 1903. This drain separating device in centrifugals for syrups and other fluids, has a number of drain channels corresponding to the various drains, and consists in a catch gutter being arranged beneath the centrifugal drum, composed of funnels arranged in adjoining rows above distributing channels arranged side by side, and leading to the actual discharge gutters, the catch gutter being freely revolubly mounted in such a way that the drain at one rotation of the catch gutter passes through a funnel division or its multiple, always into the same channel, but at corresponding *partial* rotations into other drain channels.

158614. A. W. Mackensen Maschinenfabrik and Eisengiesserei, G.M.B.H., of Schöningen. *A shreddings press the pressure spindle of which is provided with separate pressing arms or worm threads and a device for preventing the loosening of the expressed shreddings.* 11th July, 1903. This invention relates to a shreddings press in which the pressure spindle is provided with separate pressing arms or worm threads and means for preventing the stirring up or loosening of the expressed shreddings, and consists in horizontal or approximately horizontal arms which prevent the elevation and loosening of the shreddings behind the pressing members, being provided on the pressing members or on the pressing spindle in such a way that only the vertical spaces between the separate members of the press are covered.

159217. August Neumann, of Berlin. *A vacuum boiling-down pan, having a heating arrangement, arranged at the lower end of a telescopically extensible circulation pipe.* 15th May, 1904. (Patent of Addition to Patent No. 156022, of 6th December, 1903.) This is an improvement on the vacuum boiling-down pan described in Patent No. 156022, characterised by a funnel-shaped head, arranged above a telescopically extensible circulation pipe, being connected with the uppermost part of said pipe without any intermediate space, and the free space which is desirable at the commencement of the boiling-down between the head piece and the circulation pipe, obtained by drawing up the funnel-shaped piece to the top, together with the circulation pipe, which is thereby extended, above the uppermost edge of the heating apparatus.

IMPORTS AND EXPORTS OF SUGAR (UNITED KINGDOM)

To end of March, 1904 and 1905.

IMPORTS.

Raw Sugars.	Quantities.		Values.	
	1904.	1905.	1904.	1905.
	Cwts.	Cwts.	£	£
Germany	1,625,655	607,554	692,651	443,165
Holland	163,465	74,293	24,785	54,731
Belgium	56,627	265,661	21,661	199,926
France	45,353	23,355	18,920	20,027
Austria-Hungary	446,373	183,215	206,541	136,217
Java	365,318	884,008	159,119	670,895
Philippine Islands	....	....	....	....
Cuba	....	....	....	....
Peru	223,364	437,112	98,156	333,171
Brazil	69,295	23,283	26,891	15,607
Argentine Republic	....	....	....	....
Mauritius	60,516	45,013	22,134	26,401
British East Indies	38,300	62,109	15,463	33,980
Br. W. Indies, Guiana, &c.	245,288	334,637	156,301	295,034
Other Countries	176,666	288,223	81,732	220,071
Total Raw Sugars	3,413,529	3,229,873	1,524,354	2,449,315
Refined Sugars.				
Germany	2,256,982	2,204,897	1,247,126	1,908,831
Holland	775,460	387,259	451,363	342,977
Belgium	101,767	89,038	56,669	78,243
France	568,640	223,145	302,890	198,492
Other Countries	151,346	161,568	79,659	134,705
Total Refined Sugars	3,854,195	3,065,907	2,137,707	2,663,248
Molasses	324,949	522,876	63,941	116,004
Total Imports	7,592,673	6,818,656	3,726,002	5,228,567

EXPORTS.

British Refined Sugars.	Cwts.	Cwts.	£	£
Sweden and Norway	5,944	6,187	3,415	5,265
Denmark	32,478	17,392	16,649	14,155
Holland	15,066	19,365	7,920	16,733
Belgium	2,701	1,148	1,512	910
Portugal, Azores, &c.	2,568	4,089	1,475	3,367
Italy	1,357	16	637	16
Other Countries	71,638	46,057	44,834	44,876
	131,752	94,254	76,442	85,322
Foreign & Colonial Sugars.				
Refined and Candy	6,429	4,435	4,514	4,404
Unrefined	23,475	10,933	12,450	8,999
Molasses	35	240	17	101
Total Exports	161,691	109,862	93,423	98,826

UNITED STATES.

(Willett & Gray, &c.)

(Tons of 2,240 lbs.)	1905. Tons.		1904. Tons.
Total Receipts, Jan. 1st to April 20th ..	647,079	..	599,948
Receipts of Refined ,, ,, ,, ..	383	..	75
Deliveries ,, ,, ,, ..	625,073	..	591,599
Consumption (4 Ports, Exports deducted) since 1st January	458,875	..	501,872
Importers' Stocks (4 Ports) April 19th..	22,006	..	20,510
Total Stocks, April 26th	284,000	..	183,627
Stocks in Cuba, April 26rh	350,000	..	245,483
	1904.		1903.
Total Consumption for twelve months ..	2,727,162	..	2,549,643

CUBA.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1904 AND 1905.

(Tons of 2,240lbs.)	1904. Tons.		1905. Tons.
Exports	454,278	..	473,634
Stocks	286,403	..	319,320
	740,681	..	792,954
Local Consumption (three months)	11,740	..	11,930
	752,421	..	804,884
Stock on 1st January (old crop)	94,835	..	——
Receipts at Ports up to March 31st	657,586	..	804,884

Havana, 31st March, 1905. J. GUMA.—F. MEJER.

UNITED KINGDOM.

STATEMENT OF IMPORTS, EXPORTS, AND CONSUMPTION FOR THREE MONTHS ENDING MARCH 31ST.

SUGAR.	IMPORTS. 1903. Tons.		IMPORTS. 1904. Tons.		IMPORTS. 1905. Tons.	EXPORTS (Foreign). 1903. Tons.		EXPORTS (Foreign). 1904. Tons.		EXPORTS (Foreign). 1905. Tons.
Refined	206,361	..	192,709	..	153,395	274	..	321	..	221
Raw	146,380	..	170,676	..	161,493	502	..	1,174	..	546
Molasses	19,798	..	18,247	..	26,144	2	..	2	..	12
Total..........	372,539	..	379,632	..	341,032	778	..	1,497	..	779

	HOME CONSUMPTION. 1903. Tons.		1904. Tons.		1905. Tons.
Refined..	193,834	..	203,712	..	147,011
Refined (in Bond) in the United Kingdom	—	..	124,153	..	115,729
Raw	132,160	..	26,548	.	18,976
Molasses	17,800	..	20,495	..	26,621
Molasses, manufactured (in Bond) in U.K.	—	..	16,611	..	14,296
Total	343,794	..	391,519	..	322,633
Less Exports of British Refined....................	8,127	..	6,587	..	4,712
Total Home Consumption of Sugar	335,667	..	384,932	..	317,921

STOCKS OF SUGAR IN EUROPE AT UNEVEN DATES, APRIL 1ST TO 26TH, COMPARED WITH PREVIOUS YEARS.

IN THOUSANDS OF TONS, TO THE NEAREST THOUSAND.

Great Britain.	Germany including Hamburg.	France.	Austria.	Holland and Belgium.	TOTAL 1905.
189	857	535	453	113	2148

	1904.	1903.	1902.	1901.
Totals	2842 ..	2763 ..	2899 ..	2182

TWELVE MONTHS' CONSUMPTION OF SUGAR IN EUROPE FOR THREE YEARS, ENDING MARCH 31ST, IN THOUSANDS OF TONS.

(Licht's Circular.)

Great Britain.	Germany.	France.	Austria.	Holland, Belgium, &c.	Total 1904-5.	Total 1903-4.	Total 1902-3.
1732	1046	663	466	188	4095	3866	3369

ESTIMATED CROP OF BEETROOT SUGAR ON THE CONTINENT OF EUROPE FOR THE CURRENT CAMPAIGN, COMPARED WITH THE ACTUAL CROP OF THE THREE PREVIOUS CAMPAIGNS.

(From Licht's Monthly Circular.)

	1904-1905.	1903-1904.	1902-1903.	1901-1902.
	Tons.	Tons.	Tons.	Tons.
Germany	1.575,000 ..	1,927,681 ..	1,762,461 ..	2,304,923
Austria	893.000 ..	1,167,959 ..	1,057,692 ..	1,301,549
France	625,000 ..	804,308 ..	833,210 ..	1,123,533
Russia	940,000 ..	1,206,907 ..	1,256,311 ..	1,098,983
Belgium	173,000 ..	203,446 ..	224,090 ..	334,960
Holland	135,000 ..	123,551 ..	102,411 ..	203,172
Other Countries .	340,000 ..	441,116 ..	325,082 ..	393,236
	4,681,000	5,874,968	5,561,257	6,760,356

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☞ The Editor is not responsible for statements or opinions contained in articles which are signed, or the source of which is named.

NOTES AND COMMENTS.

The Price of Sugar.

By means of judicious questions in the House of Commons from time to time, Mr. F. Platt-Higgins, M.P., renders the sugar industry useful service. His latest question has drawn from the Board of Trade a statement as to the prices of sugar for present and future deliveries. These reveal a considerable fall since January. The value of these questions in the House lies mainly in the attention drawn to the information given, and their interrogation is therefore to be welcomed. We have not had so much complaint lately about ruinous prices and ruined confectioners; these latter gentlemen have little cause to make themselves heard just now. As Mr Bonar Law said in the House, the price of 88 per cent. beet sugar, f.o.b. Hamburg, at the beginning of January, was 14s. 10d. per cwt., and this had increased by the middle of January to 16s. The price on May 18th was 11s. 7½d. The price quoted on May 18th for delivery in November-December was 9s. 11d. The average price of the same sugar in the ten years 1892-1901 was about 10s. 9d. per cwt. This proves all we have hitherto claimed, that the drought, and not the Convention, was the sole cause of high prices, and now that the effects of the former are passing off, we are seeing a return to natural prices, based on cost of production. And we are glad to see that the Radicals have been thereby deprived of a most

insidious party cry, one that was calculated to mislead all those who were incapable of discerning the truth of the matter. The much abused Brussels Convention should now be allowed to run its own course, and we are sanguine that when the time comes for renewing it, the demand for its rejection will obtain little support.

West Indian Administration.

It was something of a coincidence that our article last month on "The West Indies and their Future" was followed in a few days by a debate in the House of Commons on West Indian Administration, when Mr. Norman Lamont, the well known planter, moved that "In the opinion of this House it is desirable to extend federal institutions in the British West Indies in order to cheapen and improve the administration of those colonies." He desired to see effect given to the recommendations of the 1884 Commission, which advocated the expediency of bringing the West Indian Colonies more closely together, and of promoting free trade among those colonies with a common tariff fixed as low as was compatible with revenue purposes. At present, he said, the West Indies was a protectionist's paradise, and each small island was overburdened with independent officials and all the paraphernalia of State. Education, too, was backward, there being no system of scientific or technical training in vogue, such as would greatly assist the sugar industry, and it would be impossible, in his opinion, for the West Indies to compete with America and Germany until they had scientifically trained chemists for work in factory and field. For all this, he considered a strong central Government was indispensable, with a capital at, say, St. Lucia, where the Chief Administrator should reside.

Mr. Lyttelton, in reply, expressed himself in sympathy with much of what Mr. Lamont had said; but pointed out some difficulties. For one thing, the geographical position of the various islands was not fully realized. As an illustration of distances, he instanced Barbados and Jamaica, which were nearly as far apart as the Isle of Man and Madeira; and it would be considered an extraordinary proposal to federate the latter two islands. Another point was the varying origin of the islands; Barbados and Jamaica have always been British; Trinidad was once Spanish, and British Guiana Dutch; and in several other islands a French *patois* is talked. He would like to see a strong man like Lord Cromer appointed as Governor-General for these regions for a long period to carry out a continuous and definite policy. But the present state of roads, steamer routes, and travelling facilities in general was far too backward and inefficient to ensure the necessarily prompt means of inter-communication which would be needed. In conclusion, he said the Government agreed in principle that it was desirable to have unification, but the present moment was not an opportune one for bringing about a constitutional

change. Until the Colonies had recovered from the economic losses and physical distresses they at present suffered from, it would be unadvisable to make any alteration in the existing system of administration.

The Outlook for Java Sugar.

Trade reports from Amsterdam would suggest that the position of the Java plantations as to successful production is unsatisfactory, and shows no great prospect of improvement; receipts from Java have fallen off considerably. But the depression caused by the low prices of 1902 has adversely influenced Java for some years, and now that prices have risen to a normal level, the prospects may be considered brighter than they have been for many years, and we shall be surprised if the energetic planters in that island do not soon make the most of their opportunities. The 1905 crop will not it is true be so abundant as last year's, but the mill owners are sure to have every reason to be contented.

Vibration in Sugar Machinery.

The *American Machinist*, in an article on vibration in machinery, quotes three instances of the effects of an unbalanced mass when rotating at a high rate of speed, and the means employed to overcome these undesirable effects. The third case (to quote our contemporary) was that of a sugar mill connected direct to an electric motor, and running at 2,500 revolutions per minute. This mill had previously been driven from an overhead shaft by means of a broad belt, and had given no trouble. As the mill was being shifted in position, and there was a long length of shafting with no other machines driven from it, it was decided to instal an electric motor, and to preserve the alignment of the shafts, the motor and the mill were fixed on a grey-iron bedplate; the journals of the mill at the same time being re-babbitted, as they were slightly worn.

Before leaving the shop a trial run was made, when the mill ran very smoothly, the bedplate simply sitting on the concrete floor. The mill was then installed on the floor on the first flat; the under side of this floor carrying the shafting for driving a large number of machines on the ground floor. When the mill was started up, the vibration produced in the floor was very great, causing a curious numbed feeling when standing at the machine for some time, and the various tools lying on the floor showing a tendency to travel about, which greatly amused those who were not responsible for the machine.

As this state of affairs could not be tolerated, an investigation was made. The motor was disconnected from the mill and run by itself, when it was seen that it was the mill that was at fault, as there was no vibration. The mill spindle was then taken out and tried for balance,

and found to have a heavy side on it; as it had not been giving any trouble previously to being shifted, this had not been examined when at the works. The spindle was also found to be slightly worn. This was trued up and the mill balanced. To prevent any trouble which might occur through the shafts not being exactly in line, the coupling, which was of the sleeve type, was bored slightly larger than the shaft for the mill, the motor end being a tight fit; to prevent any twisting action, two keys were fitted, one on each side of the shaft. This allowed the motor shaft and the mill shaft some slight end play, and did not make so rigid a connection.

To avoid any trouble which might be caused when working, by some of the sugar adhering to one side of the mill and putting it out of balance and so causing vibration, about 1 inch thickness of felt was placed underneath the bedplate of the machine, and the machine was bolted down to the joists, felt also being placed between the bottom bearers and the joists, thus practically insulating the machine from the floor. There was no felt underneath the mill when driven by belt, the belt appearing to steady the machine and absorb any vibration. When starting up the machine after alterations, there was practically no vibration, the machine running very satisfactorily.

The Want of Sugar Factories in India.

Mr. A. E. Jordan, A.M.I.M.E., writes to the *Times of India* calling attention to the fact that in the Bombay Presidency alone there are over 56,000 acres of sugar cane under cultivation, but not a single sugar factory for making white sugar direct from the cane. While enormous capital has been sunk in establishing cotton mills, no attention is given to the erection of sugar mills, although the latter would be by far the more profitable concern of the two. And that there is a great demand for white sugar, the imports of that commodity into Bombay from Java, Mauritius and Europe clearly show. Mr. Jordan thinks it probable that the existing condition is due to want of knowledge of how to make white sugar, as contrasted with "jaggery" or "gur." At the same time there is no doubt that if some capitalists would come forward and erect some central factories, an ample supply of canes would be forthcoming, and India would be able to herself supply much of the white sugar which at present is sent to her from Europe. This will be all the more advisable, when we consider that in the near future the home consumption in Europe may increase so much as to leave less sugar available for export to the East.

It is reported that, including the stocks in hand on January 1st, the Australian sugar output for the current year will meet the entire local consumption, which is calculated at 200,000 tons.

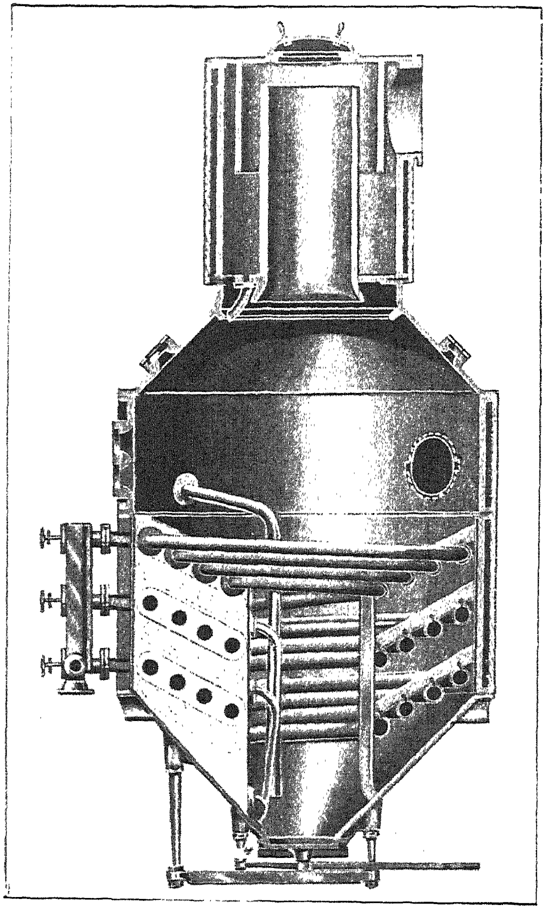


Fig. I.

MODERN SUGAR MACHINERY.

(Continued from page 230.)

Vacuum Pans.

In the accompanying plate (Fig. I.) will be found an illustration of one of Messrs. Fawcett, Preston & Co.'s Standard Cast-iron Vacuum Pans with Patent Worms. The latter are made on the "Chapman Vickess" system, which gives the maximum evaporation per unit of surface. The bodies of these pans are made of cast-iron of suitable thickness, and for the smaller sizes are made in two pieces. The larger sizes are made in segments and plates, built up, machined and fitted together. A large size saveall is fitted on the top of the pan to separate the steam from all liquid which might otherwise be carried over into the condenser. The worms are made of solid drawn copper tubing, and are stayed together and to the pans; an efficient trap is also provided, connected to the tail pipes of each worm by iron pipes on the outside of the pan. The mountings fitted to the pan include a manifold steam stop box, containing high and low pressure valve to each worm, and a pressure gauge on each; discharge valve with gear; buttercup; air valve; two proof sticks; vacuum gauge; thermometer; peep glasses and frames and a syrup supply valve.

Fig. II. shows a Calandria type of Vacuum Pan made by the Mirrlees Watson Co., Ltd., a type largely used in the Hawaiian Islands, and also in Cuba. Its principal features are the substitution of a calandria for the usual coils. The calandria has vertical tubes of comparatively large diameter for the upward circulation of the masse-cuite during boiling, and a large central tube for its downward circulation. To facilitate graining and circulation there are coils fixed below the calandria in the conical bottom of the pan.

This type of pan enables a very large amount of heating surface to be used at a minimum of cost, consequently it is claimed to be the best type of pan for use with low pressure steam.

The illustration, Fig. III., shows a large Vacuum Pan of special design in process of erection by Messrs. A. & W. Smith & Co., Ltd., of Glasgow. The pan is 13 feet in diameter with a mid piece of 11 feet deep, the strike of dry sugar being 35 tons and the heating surface about 1,900 square feet. The coils are lyre-shaped as shown in the front of the picture.

The pan is fitted with a dry air condenser and is worked by a dry air pump of the slide valve type. The coils are all short, and are level, having no reduction in the diameter and are consequently freely drained. The advantage of the level coil is most clearly proved in the bottom of the pan, where the whole heating surface of one coil is

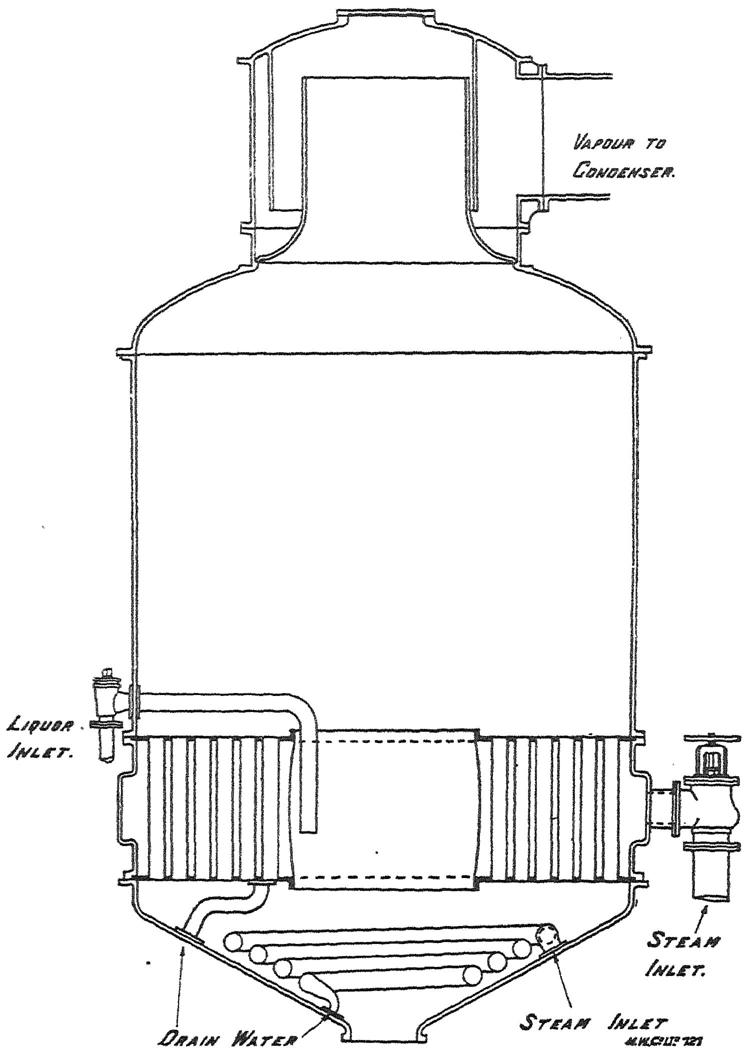

VAPOUR TO
CONDENSER.
LIQUOR
INLET.
STEAM
INLET.
DRAIN WATER
STEAM INLET

FIG. II.

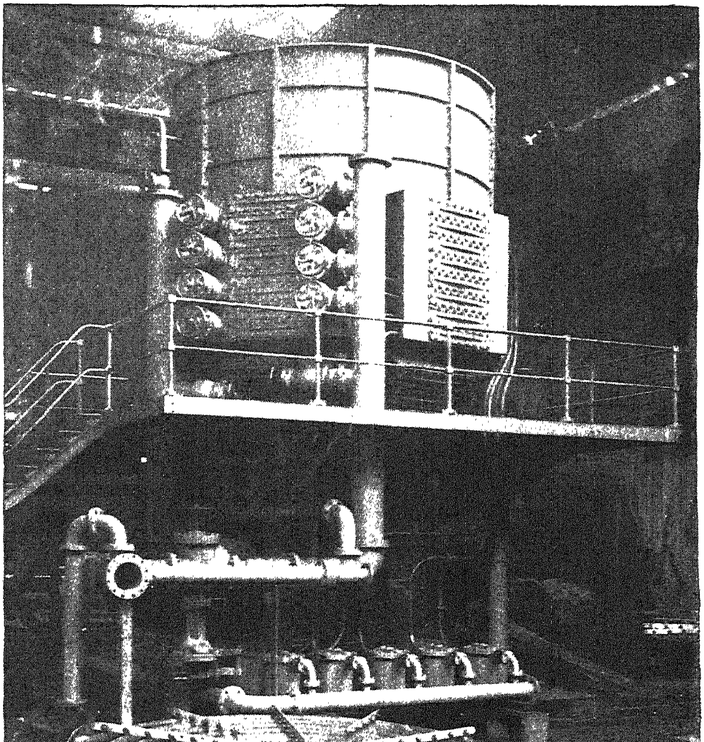


Fig. III.

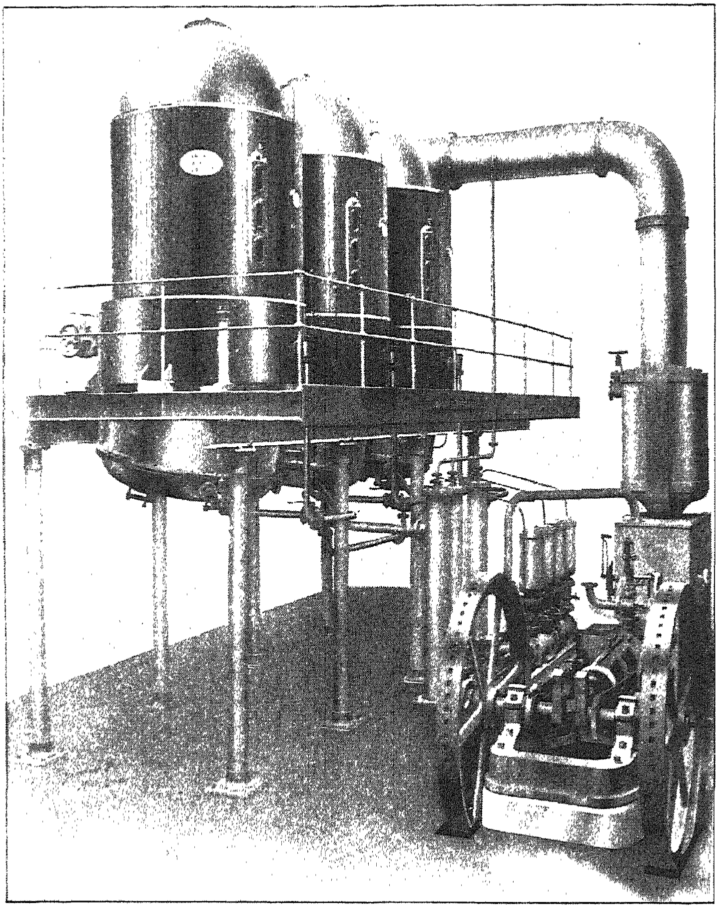


Fig. IV.

utilised by a very small additional amount of liquor. The difference in this respect between the level coil and the ordinary coil needs only to be mentioned to be appreciated.

The special features of the triple-effect constructed by Messrs. John McNeil & Co. are the setting of the calandrias at a certain inclination off the vertical line, and the device for the prevention of entrainment. Its general appearance is shown in Fig. IV.

The sectional elevation (Fig. V.) shows the sloping calandria and the arrangement of tubes in same; it also shows the provision for admission of steam, drainage of the water of condensation, escape of air, ammoniacal and other gases; and it will be readily seen how the design lends itself to ensuring a free passage of the heating vapour all through, and among the tubes a free and rapid run-off for the resulting water, and an easy escape for air, &c.

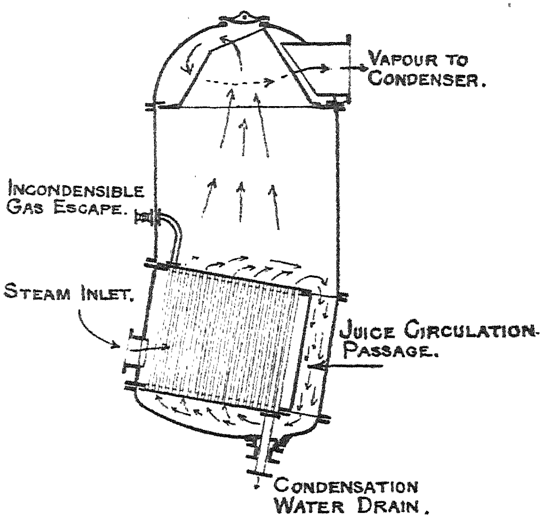


FIG. V.

On the side of the calandria opposite the steam inlet there is a large circulation passage for the syrup; it extends half-way round the calandria, and is crescent-shaped in plan. Towards this circulation passage the hot syrup issuing from the slanting tubes is thrown over in a continuous stream all the time the apparatus is at work, and leaves nothing to be desired by way of syrup circulation.

The admission of juice or syrup adopted recently by this firm tends also to assist vigorous circulation, for being admitted through a perforated copper pipe over the highest part of the upper tube plate

and extended through a considerable arc, the incoming juice enters in jets to mingle with the other juice flowing down to the circulation passage.

The device for entrainment prevention has already been described in these pages, and need not be further referred to now. The patentees state that the utility of the invention is now thoroughly established, and its extended application has only furnished further proof of its efficiency in practically eliminating all risk of sugar being swept on to the condenser and lost.

The result of trials of this triple-effect is that under ordinary favourable conditions a duty has been attained of one gallon of juice concentrated from 8° to 28° B. per hour per square foot of heating surface.

THE SUGAR POSITION.

Under the above heading, Mr. George Martineau, C.B., lately contributed two interesting and lucid articles to the *Standard*. He began by referring to the time when we imported only raw cane sugar and made our own refined sugar, besides exporting a certain amount. But with the rise of the bounties a gradual and far-reaching change spread over the sugar industry. The Paris bounties led the way, and just when there was some hope that they might be abolished, Germany and Austria introduced bounties in their own countries to father the new beet sugar industry. From then till 1902, the history of the European beet sugar crop has been one record of progress. Mr. Martineau quotes the figures of production and consumption for 1902 in Germany and Austria.

	Production.	Consumption.	Surplus exported.
Germany	2,300,000 ..	743,000 ..	1,144,000
Austria	1,171,000 ..	349,000 ..	739,000

After showing what the bounty system led up to, Mr. Martineau proceeds to quote (i.) M. Yves Guyot, where he said "The success of the Sugar Conference is the most important achievement of economic liberal policy in Europe since the signing of the Commercial Treaties of 1860"; (ii.) Sir Robert Giffen, who originally opposed the Sugar Convention, but afterwards admitted that it was a "general movement in favour of free trade"; and (iii.) the opinion of a firm of confectioners who wrote in 1889 expressing the "firmest conviction" that with the abolition of bounties "this Kingdom would be provided with a larger, a better, a cheaper, and a more reliable supply of sugar than it has ever yet had."

Mr. Martineau quotes that stock formula which is now in use in every political speech on the subject, that as the German Cartel

bounty amounted to £5 per ton, and we consume 1,600,000 tons, therefore we enjoyed a bounty of $5 \times 1{,}600{,}000 = £8{,}000{,}000$ per annum; he shows how absurd it is, as owing to the immense fluctuations in price, the bounty simply ensured that the producer could make a profit, when working under natural conditions would otherwise result in loss. But this latter loss invariably caused a shortage of supplies, and a subsequent rise in price occurred the next year when the consumer got none of the bounty.

But although bounties have ceased, there is no fear of losing that useful source of supply, the Continental beet sugar industry. It is too well organized, and too well supplied with skilled men to be likely to go to the wall. The cane sugar industry may also look forward to an era of prosperity; cane sugar can be produced at a cost of 1s. per cwt. less than beet, and if the intelligence which is associated with the beet sugar industry should be also applied to the cane sugar industry, the latter will have everything to gain.

Turning now to the first effect of the abolition of the bounties on the beet sugar industry, Mr. Martineau considers it most striking and at the same time most satisfactory. He writes:—

"The bounties had cost much money and involved heavy consumption duties to raise the necessary funds. The French indirect bounty from 1884 to 1903 amounted to something like £50,000,000, all of which came direct from the pockets of the French consumer. He also had to pay the direct bounty. When these were abolished, the duty could be reduced from 64 francs to 27 francs per 100 kilogrammes without loss to the revenue, with great relief to the consumer, but, above all, with enormous effect on the consumption. The increase was quite startling. The same change took place in Germany; but there another element entered into the calculation. In that country, where the consumption duty was 20 marks per 100 kilos., the import duty was 40 marks. The Cartel made the most of this margin, and forced the consumer to pay not only the 20 marks of consumption duty, but also a very large slice of the other 20 marks of surtax. In fact, in 1902 the price was raised more than 15 marks above the natural duty-paid value. That was the Cartel bounty. The Convention abolished it by insisting that the import duty should not exceed the consumption duty by more than six francs per 100 kilos. The consumer, therefore, immediately got his sugar cheaper to the extent of the Cartel bounty. The consumption duty was also reduced from 20 to 14 marks per 100 kilos. In Austria the consumer, in the same way, benefitted by the abolition of the Cartel bounty, but enjoyed no reduction of the consumption tax. Belgium also made a large reduction in the duty. The total effect of these changes has been that the consumption, per head of the population, was as follows for the two years previous to and the one year after the Convention.

in kilogrammes (*Journal des Fabricants de Sucre*, Paris, April 12th, 1905):—

	1901-2.		1902-3.		1903-4.
Germany	13·67	..	12·84	..	19·51
Austria	8·34	..	7·91	..	10·61
France	12·47	..	10·71	..	20·11
Belgium	9·61	..	9·93	..	15·29

"It will be observed that the figures for the year 1902-3 are below those for 1901-2, the reason being that during the months preceding 1st September, 1903, when the reduced duties came into force, consumers lived on their invisible supplies. This reduction in visible consumption made the figures for 1903-4 rather higher than they would have been if there had been no such temporary reduction, and, therefore, we may expect that consumption for 1904-5 will show some falling-off from the preceding campaign. To that extent the figures for 1903-4 are a little deceptive, but in any case they remain sufficiently striking to call for considerable congratulation at one highly beneficial effect of the Convention, an effect which will no doubt go on increasing."

Mr. Martineau next recapitulates the circumstances under which the low prices of 1902 gradually rose to the figure of 8s. 9d. last autumn, and shows how, but for that unexpected factor, the drought, this latter price might have continued all winter. But the great drought reduced production by 1,000,000 tons, with the natural result that prices rose to over 14s. 2d. However, this deficiency will bring about largely increased sowings, and given good weather the next crop will knock prices down considerably. They have already fallen to below 12s.

As Mr. Martineau was interested in the first attempts made 30 years ago to grow sugar beets in this country, it is worth while learning his opinion of the new trials recently inaugurated. He concludes his second article with these words:—

"The final consideration with regard to the sugar position created by the abolition of bounties is, perhaps, one of the most important. It was shown, more than 30 years ago, that sugar-beet could be grown in this country with as much success as on the Continent; but the bounties at that time stood in the way of further progress. That impediment having been removed, there is no reason why we should not produce from our own land and with our own labour some of the sugar we consume. The country, I know, is absolutely apathetic on the subject, ignorant of the blessing that such an industry would bring to the British farmer, and in some cases even sufficiently prejudiced to declare such a scheme to be impracticable. On the other hand, enthusiasts have over-stated their case and published figures of a seriously misleading character. But if those with cool heads, long purses and sound business habits would take up the

subject, learn their lesson, and be sufficiently humble to put the matter in the hands of a thoroughly competent foreign expert, they might confer such benefit on agriculture and labour in this country as would make them famous for ever as the saviours of the British farmer. There must be no experimenting on a small scale, the thing must be done with all the well-established latest improvements and on such a scale as to make success a certainty by reducing cost of production to a minimum. The very best land must be chosen, and plenty of it, well situated with regard to rail and water carriage, and with the certainty of obtaining a full supply of roots, cultivated in the most approved fashion and contracted for in advance for several years. Under such circumstances, we shall have a new industry—agricultural and manufacturing—of the very first importance. One successful factory will show the way to hundreds more, and we shall again hold up our heads as agriculturists with a real home industry. To make the machinery for such an industry will require another new departure. The growing of the roots, we shall soon discover, will give us new ideas of farming and new energies on the land. Crops all round will improve, cattle will multiply, the railways and canals will discover new employments, and the labourer will go back to the land. This is a dream, but it can be made a reality."

In packing goods for export to Persia, manufacturers should always take into consideration the fact that the highways are very bad. Sugar, for example, should be especially well packed, as it is easily dissolvable, and cannot be packed in sacks, for the reason that it will not withstand the wear and tear of caravan transportation. The amount to be shipped should be divided into small quantities and packed in straw.

At the Indian and Colonial Exhibition now being held at the Crystal Palace a very ingenious plant is being shown in operation by the Essex Flour and Grain Co., filling, packing, weighing, and sewing up the mouths of their bags of flour. This Sack Sewing Machine is known as Timewell's Patent Sack Filling, Weighing, Packing and Sewing Machine, and is built in a number of sizes and designs for a variety of purposes. Bags from 1 lb. up to a full-size sack holding 2 cwts. or more can be filled and sewn by these machines and much labour saved. The fastening up of the bag or sack by sewing across the mouth a strong seam with thread gives the sack a more even appearance than those hand-tied, and renders it practically sealed, as it cannot be tampered with without detection. The filled bags as they leave the machine can be discharged on to the floor, down a chute, or on to a conveyor to railway trucks, barges, &c. The owner of the patents and manufacturer of the machines is the Sack Filling and Sewing Machine Syndicate Ltd., of 89, Chiswell Street, E.C., from whom all particulars can be obtained.

JAMAICA NOTES.

Unsettled weather has been experienced during March, but the crop has not been affected.

The firmness of the sugar market and the relative high prices now being obtained for cane sugar are having a healthy effect in stimulating planters to extend the area of their cultivation. Coincident with this revival of the industry, certain schemes are on foot for the establishment of central factories, one in Vere and the other in St. Elizabeth. The one in Vere has already taken shape, the firm of Messrs. De Pass & Co., of London, having bought Morelands estate in Vere for that purpose. Plans for the buildings and machinery have been submitted, and it is possible that the work of erecting the necessary buildings will start within the next couple of months.

Meantime several estates, notably Denbigh and Cornwall, are practically working on the central factory system, and the small cultivators are being induced to cultivate canes; and to enable them to do so, the larger planters are making them cash advances.

Mr. R. G. Melhado, who has recently taken over Lodge estate on a lease from Colonel Kitchener, is about to erect new buildings and instal machinery of a larger capacity. Mr. John Hudson, of Retrieve, in Westmoreland, has ordered a new and powerful five-roller mill of a similar pattern to the one erected at Denbigh, and has also extended the acreage of his cultivation. Mr. Walter Farquhason has ordered a triple-effect plant for Retreat, Westmoreland. There are also new developments at Phœnix, Mr. Arnold Clodd's Hanover estate, where cane cultivation will be carried out on an extensive basis. Mr. S. Clarke is planting out 100 acres of canes at Sweet River, Westmoreland, while it is reported that the acreage on Fairfield estate is likely to increase.

In the Plantain Garden River District it is proposed to put down a large plant, designed to manufacture 20,000 tons of sugar annually, and negotiations which are proceeding with the landowners of the district are well advanced. One fruit estate, however, rather blocks the way to the securing of a consolidated area under cane cultivation, but arrangements are being made to secure a right of way for a tramline to connect with the outlying areas under cane cultivation.

The central factory scheme promoted by Mr. Eglan, an English financier, contemplates the erection of a 10,000 ton plant, but the site has not yet been definitely decided upon. Alternative proposals for the erection of the plant at the junction of the railway lines at Spanish Town, or in the vicinity of Haitlands are under consideration. The first presents many obvious advantages as it would tap, not only

the Haitlands and Old Harbour districts, but would also serve the district of St. Thomas in the Vale. The difference in the cost of haulage of canes from the last mentioned district as compared with the first is 6d. per ton, which it is feared would have a prejudicial effect in retarding the revival of the old industry on the estates round Linstead and Bog Walk. The available cane lands in the vicinity of the factory whether it be placed at Haitlands or Spanish Town amount at least to 5,000 acres irrespective of the canes which would be obtainable from the small settlers in the backlands.

Fewer complaints are now being heard with regard to the working of the irrigation system in Vue, and some of the planters express their satisfaction with the supply now being obtained. If the catchment basin at Raymonds had better holding properties there would be no doubt as to the successful working of the scheme. The loss at Raymond's Dam through leakage through the permeable soil is stated to be still very large, but time will eventually remedy this defect.

The landowners who take water from the Irrigation Works are greatly opposed, and properly so, to the Bill before the Legislative Council to increase the charge for the water.

Mr. C. E. Demercado's plan for the erection of a central sugar factory at Morelands has not met with any great measure of local support. The scheme contemplates the erection of a plant capable of dealing with 2,000 acres of canes. Provision will be made for space for the erection of additional vacuum pans and effects as the supply of farmed canes increases.

These extensions of existing cane cultivation and the developments of improved methods in manufacture are of great significance, and augur well for the future of the sugar industry in this colony. The crop now being taken off promises to be a very good one, and in quantity is likely to overtop considerably the record of the last three seasons; while in value it will easily exceed all years since 1899-1900. Up to last reports 10,774 puncheons of rum had been exported, which is 100 puncheons better than last year's crop; while sugar exports are 1,200 tons less, but this will easily be made up between now and crop over.

Another remarkable feature of the sugar industry is the demand for small cane mills, the sales of which in February exceeded those of the six previous months.

CANE VARIETIES IN TRINIDAD.

At the Trinidad Agricultural Conference last January Dr. A. Urich, Ph.D., Analyst and Technical Chemist to the Trinidad Estate Co., Limited, read a paper on the comparative yields of the Bourbon Cane, White Transparent, and D. 95 at Brechin Castle Estate, Trinidad, during 1904. His paper as given in the *West Indian Bulletin* was as follows:—

TRINIDAD.

On the invitation of the President Dr. A. Urich, Ph.D., F.I.C., Analyst and Technical Chemist to the Trinidad Estates Company, Limited, read the following paper on the "Comparative yield of the Bourbon Cane, White Transparent, and D. 95, at Brechin Castle Estate, Trinidad, in 1904":—

The remarkable falling off of the favourite Bourbon Cane on some estates in Trinidad makes its replacing by another variety a matter of such importance that the results obtained on one of the leading estates on a large scale with the White Transparent and the D. 95 are the more interesting, as they comprise an area of 1,762 acres and are, therefore, more reliable than if obtained on mere experiment plots.

Brechin Castle Estate, the property of the Trinidad Estates Company, Limited, is situated on the flat banks near Couva and was always known for the heavy crops of cane. Returns of 23 tons (long tons) cane per acre, all Bourbon, were frequent. The mean yield from 1895 to 1899 was 22 tons, which is comparatively high, considering the limited dose of 2 cwt. of fertilizers per acre. But since that time the yield sunk to 19 and 18·5 tons per acre, whilst an ever-increasing area practically refused to grow Bourbon.

There was nothing wrong in the chemical composition of the soil, neither could fungus, root disease, neglected drainage or tillage be made responsible for the failure, neither was it lack of fertilizing, for a dose of 3 cwt.* had been applied per acre. But it became imperative to replace the Bourbon by another variety. Frequent previous trials with White Transparent and D. 95 had given such encouraging results as regards tonnage that in 1904 the area cropped under Bourbon was reduced to 603 acres, whilst that under White Transparent had risen to 934 and that under D. 95 to 225 acres.

The Brechin Castle Usine is supplied with canes from three groups of estates which we will call A, B, and C. The difference of the soil is shown by the following analyses:—

*The fertilizer was composed of 3·4 per cent. nitrogen as sulphate of ammonia, 2·5 per cent. nitrogen as nitrate of soda, 11 per cent. phosphoric acid from superphosphate and 4·3 potash, costing $6 per acre.

	Light soil. Per cent.	Medium soil. Per cent.	Heavy cla .. Per cent.
Organic matter and combined water..	4·80	7·60	10·35
Containing nitrogen..	0·113	0·141	0·350
Sand and insoluble silicates	81·40	72·30	61·00
Moisture	2·20	3·70	6·20
Lime	0·325	0·269	0·857
Potash..	0·433	0·439	0·762
Phosphoric acid	0·140	0·120	0·209
Available potash	0·027	0·020	0·022
,, phosphoric acid (soluble in 1 per cent. citric acid)	0·021	0·010	0·017

Rainfall in 1903 = 59 inches.

In sections A and B medium and occasionally light soils prevail, whilst section C is a heavy clay.

The annexed statement was compiled from data kindly supplied by Mr. T. Arbuckle, the manager of the estate. It shows the yield in plant canes, first and second ratoons for each section of the estate. The term "true average" means the calculated yield in cane per acre, had exactly the same area (one-third) been planted in plant canes, first and second ratoons.

The falling off of the Bourbon cane was noticed most in section A.

Section B still gave an average return of 17 tons, but the rich lands of C only gave 15·7 tons. In former years some fields of this section used to give a return of 40 tons (plant canes) per acre.

The purple cane D. 95 proved to be equally prominent as plant canes, first and second ratoons in section A, the very satisfactory return being 32·8, 21·2, and 20·9 tons respectively, equal to an average of 24 tons.

White Transparent shows a somewhat inferior but still satisfactory record in section A with 30·5 tons for plant canes, 20·7 for first and 14·3 for second ratoons. Average 23 tons. For sections B and C the average is 22·8 and 20·2 tons respectively. Taken as a whole, the 603 acres in Bourbon gave an average return of 16·43 tons per acre; 935 acres White Transparent, 22·35 tons per acre; and 225 acres D. 95, 23·65 tons per acre.

Thus far we have only considered the merits of the new varieties as regards tonnage, but an equally important item is their sugar contents. I regret not being able to supplement the above statement by the exact sucrose contents for each variety, much less the results obtained in manufacture. This was impossible owing to the bad milling qualities of the White Transparent, which made it compulsory to grind it together with a certain amount of Bourbon. But frequent single tests of the three varieties proved that even in normal dry seasons the White Transparent is a "slow ripener" and of inferior sucrose contents to the Bourbon. In a very favourable season like

1903, however, it surpassed the Bourbon in this respect in April and May.

The reverse appears to be the case with D. 95, which reaches maturity earlier than the Bourbon, surpassing it always in sucrose contents. At several times, however, a deterioration in sucrose was noticed when once maturity was attained. D. 95 and White Transparent contain much less glucose than the Bourbon.

Thus, on March 1st, 1901, the juice from the Bourbon contained 1·58 lb. sugar per gallon, the White Transparent only 1·29 lb., but D. 95, 1·96 lb., a value never noticed again during that crop. Two months later, on May 7th, the Bourbon contained 1·70 lb., the White Transparent had risen to 1·90 lb., but D. 95 had retrograded to 1·68 lb. sucrose per gallon.

Again in 1902, on February 21st, the White Transparent indicated only 1·27 lb., as against 1·50 lb. for the Bourbon. On April 4th, we had 1·69 for Bourbon, 1·58 for White Transparent, and 1·79 for D. 95. On May 4th, the Bourbon contained 1·77 lb., but the White Transparent had risen to 1·92. In the favourable dry season of 1903 Bourbon started on February 26th with 1·69 lb. sucrose per gallon and White Transparent with 1·56. On May 6th, we find 1·88 lb. for Bourbon, and 1·74 for White Transparent, D. 95 standing at 1·75 lb., which was the richest sample noticed for this cane in 1903. In the unfavourable season of 1904 neither Bourbon nor White Transparent reached maturity. On March 9th, the Bourbon indicated 1·62 lb. sucrose, but the White Transparent only 1·29. D. 95, however, contained 1·73 lb. sucrose per gallon.

After the rains in the beginning of April a retrogression in sucrose contents had already set in, for the Bourbon contained only 1·55 lb.; White Transparent, 1·45; and D. 95, 1·67 lb.

All samples examined were take from the mill juice as obtained in the factory, which explains that not so many could be taken as would have been desirable. For the grinding of the White Transparent canes unmixed with other canes was avoided as much as possible, not only on account of the difficulty to keep up a regular feed of the mills but also on account of the poor quality of the megass as fuel.

Thus, there are three serious drawbacks preventing the White Transparent from being a successful competitor with the Bourbon, viz., poor sugar content during the earlier period of the grinding season, difficulty in milling, and poor quality of the megass as fuel.

The promising seedling D. 95 is free from these drawbacks.

It is only fair to state that another Usine of the Trinidad Estates Co., "Caroni," succeeded in overcoming the difficulty experienced in milling the White Transparent with the help of a cane slicer and double crushing, and the satisfactory extraction of 72·5 per cent. from the weight of the cane was secured. Maceration of the megass was used.

The question, which cane is to replace the Bourbon where the latter has failed, is a very difficult one, for I believe the majority of our planters still share the opinion expressed two years ago in Demerara, that so far no seedling cane has been grown which, in all-round good qualities, is equal to the Bourbon. At the same time, nobody will deny that the seedling canes have special merits peculiar to them, as is fully shown in the results published by the investigators connected with the Imperial Department of Agriculture.

RETURN IN BOURBON, WHITE TRANSPARENT AND D. 95 IN 1904.

	Bourbon.		White Transparent.		D. 95.	
Section A.	Acres cut.	Tons cane per acre.	Acres cut.	Tons cane per acre.	Acres cut.	Tons cane per acre.
Plant canes ..	—	—	214	30·52	53	32·85
First ratoons....	25	9·25	287	20·73	42	21·27
Second ratoons ..	151	17·53	106	14·36	114	20·90
Total	176	—	607	—	209	—
True average	—	16·35	—	23·07	—	24·00
Section B.						
Plants	30	24·93	77	25·40	—	—
First ratoons ..	55	20·23	32	16·38	—	—
Second ratoons ..	148	14·27	—	—	—	—
Total	233	—	109	—	—	—
True average	—	17·05	—	22·75	—	—
Section C.						
Plants..	64	19·25	97	22·64	—	—
First ratoons....	28	15·33	88	18·40	16	19·10
Second ratoons ..	102	13·55	34	17·63	—	—
Total	194	—	219	—	16	—
True average	—	15·68	—	20·15	—	—

RECAPITULATION (TONS CANE PER ACRE).

	Plants.	First ratoons.	Second ratoons.	Average actual.	Acres cut.
Bourbon	21·05	16·42	15·34	16·43	604
White Transparent ..	27·53	19·88	15·15	22·35	935
D. 95	32·85	20·68	20·88	23·65	225

The output of the Formosa sugar industry for the past three years has been:—

	1902. kin.	1903. kin.	1904. kin.
Brown sugar	80,489,490	49,244,428	65,830,068
Other sugar	9,963,878	5,735,417	4,334,464
Rock-candy	85,479	48,432	69,973
Molasses	2,791,284	2,536,627	2,490,860
Total	93,330,131	57,564,904	72,725,365

CHILE.

THE SUGAR INDUSTRY.

The soil and climate of Chile indicate that the sugar industry would prosper in the Republic, if properly exploited, not only to the extent of supplying the domestic needs of the nation with that important product of prime necessity, but also in such quantities as would leave a considerable surplus for export to foreign markets. The sugar beet is one of the tubers that flourishes most luxuriantly in the lands of the central zone of the Republic. In addition to the natural adaptability of the soil and climate of Chile for the growth of this tuberous root, the country also possesses deposits of nitrate and guano which are recognised to be the best and most appropriate fertilisers in the cultivation of this highly saccharine-producing tubercle.

Unfortunately the cultivation of the sugar beet has not been sufficiently extended, due perhaps to circumstances foreign to the industry itself, and at the present time there are only two factories in the country capable of extracting and refining sugar from the sugar beet. One of these, situated at Guindos, has not been in operation since 1890, owing to the lack of the raw materials, caused by the failure of the proprietor thereof to continue on his plantation the cultivation of the sugar beet. The other installation is at Parral, and is owned by a corporation having a capital of 1,500,000 pesos. Until January last this factory only produced brown sugar, which it delivered to the refinery at Penco, but since the date mentioned new and adequate machinery has been introduced and the refining is now done in the establishment itself. The production of beet sugar in this factory during the last four years was as follows:—

Class of sugar.	1900. Kilos.	1901. Kilos.	1902. Kilos.	1903. Kilos.
First	390,604½	89,688	166,897¼	168,671
Second	75,378	9,419	42,738	35,126
Third	26,274	——	6,525	7,936
Fourth	6,525	——	——	——
Total	498,781½	99,167	216,160¼	211,733

In 1903 the factory at Parral (Membrillo) did not produce raw sugar, inasmuch as the board of directors decided not to devote their lands to the cultivation of the sugar beet, and as sugar beets are not grown in the vicinity, the factory was without the raw material with which to work.

There are two refineries in the Republic. One of these is at Vina del Mar and the other at Penco. Both belong to corporations. They

use raw sugar imported from Peru, with the exception of a small quantity already mentioned, which is supplied to them by the factory at Parral (Membrillo). Raw sugar pays an import duty of 6·50 pesos per 100 kilograms. The imports of raw sugar in 1902 aggregated 41,397,378 kilograms, valued, approximately, at 4,139,738 pesos. The quantity of white or granulated sugar imported during the same period amounted to 162,395 kilograms, of an estimated value of 24,258 pesos. Sugar of the latter class is sold in the country in the form in which it is imported, and is subject to a duty of 11·40 pesos per 100 kilograms. The imports of refined sugar during the same period amounted to 1,646,930 kilograms, valued at 329,389 pesos. Refined sugar pays a duty of 14·35 pesos per 100 kilograms. The total imports of sugar in 1902 consisted of 43,206,723 kilograms, valued, approximately, at 4,493,485 pesos.

The sugar refinery at Vina del Mar has a capital of 4,667,666 pesos, gold, of a value of 18d. The production of this refinery for the ten years is given below :—

	Kilograms.		Kilograms.
1894	11,861,203	1899	18,968,186
1895	13,174,530	1900	20,479,093
1896	13,273,210	1901	21,096,295
1897	14,292,867	1902	24,439,964
1898	16,470,310	1903	24,285,419

The average dividends paid to the shareholders during the ten years mentioned were 10½ per cent. annually on the capital invested.

The refinery at Penco is not as old as is that of Vena del Mar. It has a capital of 3,000,000 pesos, gold, of a value of 18d. The production of this refinery for ten years has been as follows :—

	Kilograms.		Kilograms.
1894..	4,444,428	1899 .. .	10,123,763
1895	6,311,522	1900	19,921,722
1896..	7,345,970	1901	10,588,419
1897	8,957,902	1902	11,324,001
1898..	10,115,360	1903	12,982,632

In 1902 and 1903 this company paid an average annual dividend to its stockholders of 9½ per cent. on the capital invested.

A recapitulation of the production of the refineries together with the imports in 1902 shows that the total consumption of sugar in the Republic in 1902 aggregated 37,573,310 kilograms, or an equivalent of 11,838 grams per inhabitant, estimating the population of Chile at 3,178,783 persons, the number given in the "Statistical Synopsis" for 1903. The average price of sugar in the Republic in 1902 was 43 cents per kilogram.—(*Willett & Gray's Circular.*)

MANURIAL EXPERIMENTS IN THE LEEWARD ISLANDS.

The Annual Reports of the Sugar Cane Experiments in the Leeward Islands are always large foolscap pamphlets filled with voluminous tables. In the last Report on Manurial Experiments, the results of four seasons' work on plant canes, and three seasons with ratoons, are placed on record, and as they are of more interest than the records of one year only, the tables relating to them are reproduced below.

In reviewing the experiments with plant canes during the four years, the Report states:—

"As pointed out in previous reports, the fields under these experiments are treated in the ordinary manner prior to the experiment plots being laid out; in most instances the plots have all received the usual dressings of pen manure or its equivalent. The experiment No. 1 'no manure' therefore represents the usual agricultural practice of these islands and may more properly be described by the term no *additional* manure, and experiment No. 2 'pen manure' should be *additional pen manure*. The experiments are thus designed to compare the results following the use of various combinations of manures when used as additions to the commonly accepted methods of the colony, and to demonstrate whether our planters should, or should not, modify this accepted practice.

"The results are best examined and compared by the use of Diagram No. 2. This makes it abundantly clear that none of the combinations of artificial manures experimented with are remunerative in practice when used with plant canes growing in fields properly prepared and manured with pen manure; nor is it necessary to increase the amount of pen manure beyond the 20 tons per acre used in the best agricultural practice. In no case, with the possible exception of No. 18,* has the increase in the quantity of cane compensated for the cost of the art ficial manure used, though in every case except two the use of the artificial manure (or in the case of No. 2, of the extra pen manure), there is an actual increase in the amount of cane produced. The exceptions are No. 23, where basic phosphate is used without nitrogen or potash when the yield is identical, on the average, with that from No. 1, and No. 30 where sulphate of potash is used without nitrogen and phosphate; here the yield, on the average, only differs from No. 1 by 0·3 tons, a negligible quantity. Nitrogen is the constituent which has produced the largest, though unremunerative, increment. The increments produced by potash are small, while phosphates have decreased rather than increased the yields. As has been repeatedly pointed out, this effect of phosphate is singular and unexpected: indeed, from the deficiency of phosphate usually

* Plots 18 received 60 lb. nitrogen as sulphate of ammonia and 60 lb. potash as sulphate without phosphate.

observed in the soils of the colony we were prepared to expect considerable increases from the use of phosphatic manures.

"These results thus briefly summarised are of great interest to practical planters as demonstrating that, under the circumstances prevailing in the Leeward Islands, and in cases where an adequate supply of pen manure can be applied to the land in its preparation for plant canes, it is unnecessary and unremunerative to employ artificial manures.

"When the soil is in good condition, but it has been found impossible to give the proper dressing of pen manure, then artificial manures may prove remunerative; under the circumstances it is suggested that either 1½ to 2 cwt. of sulphate of ammonia, or 2 to 1¾ cwt. of nitrate of soda be given in one application. A small additional profit will probably follow from the use of ¾ to 1 cwt. of sulphate of potash together with phosphate, either ½ to 2 cwt. of basic phosphate, or a similar amount of superphosphate. All of these manures should be given early."

The Report contains a useful summary concerning the application of manures to canes both *plants* and *ratoons*. This states amongst other points:—

In the Guano series we find that there is a small monetary loss in each case.

In the Potash series the largest monetary gain is obtained without the use of potash, which increases the yield so slightly as to be unremunerative. The use of potash without nitrogen and phosphate results in a loss.

In the Phosphate series there is a slight increase in the weight of cane from the use of small quantities of phosphate but none with large quantities: the use of phosphate affords no monetary gain when basic phosphate is used. Superphosphate in small quantities scarcely affected the yield, in large quantity there is a small increase, but in both cases these increments are too small to pay for the superphosphate, the largest monetary gain in this series being from No. 18, receiving no phosphate.

The use of basic phosphate without other manure does not appreciably affect the yield, and there is a small monetary loss.

In the Nitrogen series while the yields of cane are slightly greater in those cases where nitrogen is used in combination with potash and phosphate, the largest *monetary* gains result from the use of nitrogenous manures, sulphate of ammonia or nitrate of soda, without addition.

The largest monetary gain in all the experiments results from the use of 60 lb. of nitrogen as nitrate of soda (about 380 lb.) in one application, which gives a monetary gain of \$8·78 or 36s. 7d. per acre.

The gain next in order results from the use of 60 lb. of nitrogen as sulphate of ammonia (about 290 lb.) in one application, which gives a monetary gain of \$7·11 or 29s. 7d. per acre.

The results in the nitrogen series bear out those in other series, that nitrogen alone is remunerative, potash and phosphate not producing sufficiently large increments to compensate for their cost.

It is clearly demonstrated that it is more profitable to apply all the nitrogen at one time rather than to divide the application into two doses: this is borne out both in the results for the one year and on the average for three years.

We may therefore conclude that, in order to obtain satisfactory returns from ratoons, nitrogenous manures, and those alone, are essential, proper care in cultivation always being assumed. The nitrogenous manure may profitably be nitrate of soda from 2½ to 3½ cwt. per acre, or sulphate of ammonia from 2 to 3 cwt. per acre. Whichever is used it should be given in one application.

For these manures to produce remunerative effects, the soil must be in good physical condition, and proper attention must be given to ensure good cultivation and adequate weeding.

MEANS OF 38 PLOTS FOR FOUR YEARS (1900-04).

PLANT CANES.

No of Experiment.	Tons of Canes per acre.	Difference on No Nitrogen.	Difference on No Manure.
1	25·4	+ 1·9	..
2	27·4	— 0·1	+ 2·0
3	27·3	..	+ 1·9
4	29·0	+ 1·7	+ 3·6
5	28·3	+ 1·0	+ 2·9
6	29·6	+ 2·3	+ 4·2
7	29·6	+ 2·3	+ 4·2
8	28·9	+ 1·6	+ 3·5
9	28·8	+ 1·5	+ 3·4
10	28·5	+ 1·2	+ 3·1
11	29·8	+ 2·5	+ 4·4
12	27·9	+ ·6	+ 2·5
13	27·3	+ ·0	+ 1·9
14	27·5	+ ·2	+ 2·1
15	27·7	+ ·4	+ 2·3
16	27·2	— ·1	+ 1·8
17	27·7	+ ·4	+ 2·3
18	30·5	Difference on No phosphate.	+ 5·1
19	27·3	— 3·2	+ 1·8
20	29·6	— ·9	+ 4·2
21	30·4	— ·1	+ 5·0
22	29·8	— ·7	+ 4·4
23	25·4	— 5·1	+ ·0
24	29·7	— ·8	+ 4·3
25	29·9	— ·6	+ 4·5
26	27·7	Difference on No. potash.	+ 2·3

No. of Experiment.		Tons of Canes per acre.		Difference on No Nitrogen.		Difference on No Manure.
27	....	28·3	....	+ ·6	..	+2·9
28	....	29·3	....	+1·6	....	+3·9
29	....	29·6	....	+1·9	....	+4·2
30	....	25·1	....	—2·6	....	— ·3
31	....	26·6	....	..	....	+1·2
32	....	28·1	....	..	...	+2·7
33	....	27·5	....	..	....	+2·1

MEANS OF 20 PLOTS FOR THREE YEARS (1901-4).
RATOON CANES.

No. of Experiment.	Tons of Cane per acre.	Difference on No Nitrogen.	Difference on No Manure.	Value of Increment. $ c.	Cost of Manure. $ c.	Profit or Loss on Manuring. $ c.	s.	d.
1	11·7	+1·9	—	—	—	—	—	
2	14·0	—0·4	+2·3	5·98	—	—	—	
3	13·6	—	+1·9	4·94	5·18	—0·24	— 1	0
4	17·7	+4·1	+6·0	15·60	11·36	+4·24	+17	8
5	16·3	+2·7	+4·6	11·96	11·36	+0·60	+ 2	6
6	18·9	+5·3	+7·2	18·72	14·45	+4·27	+17	9
7	17·0	+3·4	+5·3	13·78	14·45	—0·67	— 2	9
8	18·1	+4·5	+6·4	16·64	10·94	+5·70	+23	9
9	17·2	+3·6	+5·5	14·30	10·94	+3·36	+14	0
10	18·8	+5·2	+7·1	18·46	13·82	+4·64	+19	4
11	18·0	+4·4	+6·3	16·38	13·82	+2·56	+10	8
12	16·2	+2·6	+4·5	11·70	16·33	—4·63	—19	3
13	15·1	+1·5	+3·4	8·84	12·57	—3·73	—15	6
14	18·0	+4·4	+6 3	16·38	9·27	+7·11	+29	7
15	17·1	+3·5	+5·4	14·04	9·27	+4·77	+19	10
16	18·4	+4·8	+6·7	17·42	8·64	+8·78	+36	7
17	16·8	+3·2	+5·1	13·26	8·64	+4·62	+19	3
18	18·3	*	+6·6	17·16	12·57	+4·59	+19	1
19	15·1	—3·2	+3·4	8·84	12·57	—3·73	—15	6
20	18·9	+ ·6	+7·2	18·72	14·45	+4·27	+17	9
21	19·0	+ ·7	+7·3	18·98	15·39	+2·59	+10	9
22	18·4	+ ·1	+6·7	17·42	16·33	+1·09	+ 4	6
23	12·5	—5·8	+ ·8	2·08	1·88	+0·20	+ 0	10
24	17·9	— ·4	+6·2	16·12	15·29	+0·83	+ 3	5
25	19·3	+1·0	+7·6	19·76	16·65	+3·11	+12	11
26	18·0	†	+6·3	16·38	11·15	+5·23	+21	9
27	17·7	— ·3	+6·0	15·60	12·25	+3·35	+13	11
28	18·1	+ ·1	+6·4	16·64	13·35	+3·29	+13	8
29	18·9	+ ·9	+7·2	18·72	14·45	+4·27	+17	9
30	12·3	—5·7	+ ·6	1·56	3·30	—1·74	— 7	3
31	13·7	—	+2·0	5·20	6·50	—1·30	— 5	5
32	16·4	—	+4·7	12·22	13·00	—0·78	— 3	3
33	15·7	—	+4·0	10·40	13·00	—2·60	—10	10

*Difference on No Phosphate. †Difference on No Potash.

An appendix deals with the effect of phosphate in sugar cane cultivation.

Attention has been repeatedly drawn to the fact that, in the Leeward Islands, phosphoric manures have not proved necessary in the cultivation of the sugar cane, provided a reasonable supply of pen manure is available. In order to extend the inquiry beyond the range of the regular experiments, supplementary experiments have been carried on, for the past two seasons. Each plot before planting received pen manure.

The mean results are given in the following table:—

No. of Experiment.	Manure.	Plant Canes. Mean of Three Stations.			Ratoon Canes. Mean of Two Stations.		
		Cane. Tons per acre.	Difference on No Phosphate.	Difference on No Manure.	Cane. Tons per acre.	Difference on No Phosphate.	Difference on No Manure.
1	No Manure	29·4	−1·3	..	11·8	−3·3	..
2	No Phosphate	30·7	..	+1·3	15·1	..	+3·3
3	40 lbs. Phosphoric Acid as basic slag	28·7	−2·0	−0·7	14·2	−0·9	+2·4

Each plot, except No. 1, received per acre:—60 lbs. *Nitrogen* as sulphate of ammonia; 60 lbs. *Potash* as sulphate of potash.

From these experiments we find that the yield of cane is not increased by the addition of phosphate to manurings of nitrogen and potash. And further, that in the case of plant canes the increase produced by artificial manures is small and unremunerative. With ratoon canes, while phosphate failed to increase the yield, there is a substantial gain on the plots receiving nitrogen and potash without phosphate: from the main series of experiments we conclude that this gain is largely due to nitrogen.

Thus, these supplementary experiments fully bear out the results of the main experiments.

THE MINERAL CONSTITUENTS OF THE SUGAR CANE.

By H. PELLET and CH. FRIBOURG.*

Many investigations have been published on the composition of the mineral matter absorbed by the sugar cane. The last to appear on the subject was by Dr. Walter Maxwell, formerly Director of the Experiment Station of the Hawaiian Sugar Planters' Association; *this being the first publication of that Station in 1899.*

In it the author examined only two varieties of canes, the *Rose Bamboo* and the *Lahaina*, and his analyses indicated the composition of the ash and the corresponding quantity of mineral matter removed by the crop per hectare of soil. The results appeared to us as quite extraordinary, both as regards the composition and the quantity of mineral matters absorbed by the canes per hectare; these are given below:—

COMPOSITION OF THE ASH OF CANE STEMS.

	Rose Bamboo.		Lahaina.	
	Per Cent.	Kilos. Per Hectare.	Per Cent.	Kilos. Per Hectare.
Silica	40·73	543	39·35	332
Acid, Titanic	1·11	13	1·63	13
,, Phosphoric	7·04	94	6·81	57
,, Sulphuric	4·90	64	6·89	59
,, Carbonic	1·45	19	1·20	18
Chlorine	2·41	31	0·67	5
Iron	5·21	69	7·66	63
Alumina	4·01	53	6·77	56
Manganese	0·43	5	0·45	3
Lime	6·09	80	6·76	53
Magnesia	3·24	43	3·28	27
Sodium	1·66	21	2·41	19
Potash	22·04	232	16·29	137

Having regard to the relatively high proportion of mineral matter removed per hectare, these results indicate that the yield from the experimental plots frequently exceeded 200,000 kg.; and in one case even amounted to 228,827 kg. of canes per hectare.

To these figures we can take no exception inasmuch as it has since been shown that, although the canefields in Hawaii have not yielded such high returns, certain fields have given as much as 25,000 kg. of sugar per hectare.

It would be interesting, by the way, to know exactly how such yields are obtained,—whether they are due to methods of planting, cane variety, climate, temperature, moisture, light, and the nature of the soil, all of which are important factors in the growth of the cane; and, further, which of these factors is the most important?

*Translated from the *Bulletin de l' Association des Chimistes.*

In those countries where the sugar cane thrives and has long been cultivated, average yields of from 90 to 110,000 kg. of cane are obtained. In Java, great difficulty is experienced in securing an average yield of 120,000 kg. per hectare.

But when we come to yields of over 150,000 kg. and attaining in one case to 230,000 kg. the difference is so great that we are surprised that no one has as yet investigated the matter more fully.

It is evident that if the soil of the Hawaiian Islands is fairly represented by that found at the Experiment Station of the Planters' Association, it is of entirely different composition to the soils of nearly every other tropical country.

Its percentage composition is as follows:—

Moisture	9·500	Protoxide of Iron	5·515
Combustible matter	9·347	Alumina	12·540
Soluble Silica	32·718	Manganese	0·145
Acid, Titanic	2·460	Lime	0·861
,, Phosphoric	1·050	Magnesia	0·821
,, Sulphuric	0·164	Sodium	0·175
,, Carbonic	0·080	Potash	0·581
Peroxide of Iron	23·630	Nitrogen	0·149

From this we see that the soil of the Hawaiian Islands is very rich in phosphoric acid and potash, and contains an ample supply of lime, magnesia, and nitrogen. Let us compare this composition with an average soil of Guadeloupe, which, according to Bonnin, contains as its principal elements—

	Per Cent.
Phosphoric Acid	0·03 to 0·3
Lime	0·02 ,, 1·2
Magnesia	0·03 ,, 0·8
Potash	0·012 ,, 0·112
Nitrogen	0·06 ,, 0·38

In Martinique, J. Rouf has indicated the following compositions as a suitable soil for cane:—

Phosphoric Acid	0·243
Lime	1·295
Magnesia	1·150
Potash	0·111
Nitrogen	0·211

In Réunion, Delteil has obtained the following results from the analysis of several varieties of soils yielding abundant returns of excellent canes:—

Phosphoric Acid	0·04 to 0·36
Lime	0·18 ,, 1·56
Magnesia	0·04 ,, 3·03
Potash	0·53 ,, 2·10
Nitrogen	0·18 ,, 0·30

As regards the composition of the ash of Hawaiian canes, we can only accept the figures in the foregoing table as being very different from those hitherto published, at least as regards the elements we have referred to in particular.

But Dr. Maxwell explains this seemingly abnormal composition in a pamphlet published in 1900 relating to analyses made not of two only but of thirteen varieties of canes. In fact, the author has frankly declared that a laboratory assistant misunderstood his instructions, and that the analysis in 1899 was made on a portion of the ash which had been washed. This accounts for the loss of a portion of the potash and the increase of certain insoluble substances, notably the silica.

In his more important work of 1900, Dr. Maxwell gives the composition of the leaves, the tops of dead and rejected canes, and of those reserved for the factory.

Confining our attention for the present to the ash of the cane stem, each variety of cane does not absorb exactly the same amount of mineral substance, as Dr. Maxwell has rightly remarked; and this point is of interest because the experiments were conducted with canes grown on the same soil. If, however, we take the mean of these 13 analyses, we arrive at what, in our opinion, closely represents the average mineral composition of the sugar cane of different countries.

We have ourselves analysed Egyptian canes by sampling the fresh chips brought to the laboratory for purposes of chemical control. From 66,884 metric tons of canes 70·730 kg. of fresh chips were burnt to a grey ash, which weighed 558 gr. The daily samples were well mixed, and a portion, always the same, carbonised, the residue preserved, and an exact analysis of the ash made after the factory ceased working.

Without going into details, we give below a table comparing our analyses with those representing the mean of Dr. Maxwell's 13 samples.

	Egyptian Canes.	Maxwell's Analysis (Haiti Canes).
Pure Silica	26·30	22·50
Phosphoric Acid	6·83	7·27
Sulphuric Acid	6·91	5·40
Chlorine	7·41	8·80
Sesquioxide of Iron	d·84	4·65
Alumina	0·	5·62
Protoxide of Manganese	0·32	
Lime	3·42	3·77
Magnesia	3·96	4·40
Potash	38·25	33·70
Soda	2·70	3·07
Sand	3·74	
Total	101·67	99·18
Less Oxygen equivalent to chlorine	1·66	
	100·000	

If we compare the percentages in this table we find, as a whole, very little difference between them; the only point of note is that in our analyses we have not mentioned the presence of alumina, whereas in the analyses of Dr. Maxwell the average percentage is 5·62. Of the 13 samples examined the minimum percentage of alumina was 2·13, and the maximum 14·04.

The question whether alumina is a constituent of vegetable matter requires investigation and proof.

H. Joulie, who has studied the composition of plants with a view to ascertaining their manurial requirements, makes no mention of alumina as entering into the composition of vegetables in any appreciable quantities. Neither does P. Deherain in his "Agricultural Chemistry" refer to alumina in his analyses of ash. Messrs. Geschwind and Sellier, in their work on the beetroot, likewise consider that if alumina is found in vegetable matter, it can only be due to impurities present. On the other hand, we might add that an error in analysis may "indicate" alumina where it does not really exist, this substance being in most cases estimated by difference. Bonâme, who has made many analyses of canes, does not mention alumina as a constituent part of the mineral substances found in the plant.

In the ash of Egyptian canes, of which we have given the analytical results, alumina was tested for by different methods. In particular, acetate of soda was used for precipitating iron and alumina as phosphates. We modified the conditions, and in one case added an excess of phosphate to ensure the complete precipitation of these elements in the form of phosphate. These tests, based on the estimation of phosphoric acid and of iron by stannous chloride, did not indicate the presence of alumina; but as they are only indirect, we could not absolutely assert that alumina was absent, but that, if present, it could only have been in very minute proportion. The direct estimation by the method of Lasne would give more exact results; we shall also study other methods. Accordingly, although we have endeavoured to trace the presence of alumina in the ash of Egyptian sugar canes without success, we intend to repeat our analyses of cane ash with special reference to this constituent, adopting the direct method of our former colleague, M. Lasne, which, although somewhat long, does not present any difficulties, and has the advantage that larger samples of the ash can be treated. Having still a quantity of this cane ash left, we intend to prove whether alumina is really present, and if so, whether the amount is appreciable.

Sometimes alumina is, indeed, found in certain vegetable ashes, but has been traced to fragments of soil which remained adhering to the plant, and this is frequently the case when analysing cane leaves. Dr. Maxwell referred to it in his pamphlet of 1900, and

stated that the normal mineral matter might be increased 25% to 40% through the presence of such adhering soil. As the preliminary operations of Dr. Maxwell's researches in 1900 were conducted under his personal supervision, there is no reason for supposing that this source of error has crept into his analyses. The presence of alumina in cane ash therefore awaits our results. If, as seems probable, our former conclusions are confirmed, then, without in any way doubting Dr. Maxwell's results, it will be interesting to repeat this special estimation of alumina in the ash of Hawaiian canes.

We would like to point out the importance of evaporating the acid solution of the ash to dryness, and of maintaining the heat at a sufficiently high temperature and for a sufficient period to render the whole of the silica insoluble. Otherwise a portion of the silica may remain soluble and be reckoned as alumina.

Dr. Maxwell has also found alumina in the ash of cane leaves, but only in minute proportion, *i.e.*, from 0·83 to 2·13 %. In his analyses of cane ash in 1899 he pointed out the presence of titanic acid in the proportion of from 1·11 to 1·03 %, which is much too high, for reasons already given. In 1900 he did not estimate the titanic acid in the ash of the cane-stem, but in that of the cane leaves and tops. This amounted to from 0·42 to 1·19 % of titanic acid—a very appreciable quantity.

In the Egyptian canes we found only 0·11 % of titanic acid in the ash, and it was only in consequence of the publication of Dr. Maxwell's analyses that we tested for titanium and found it to be present. It is probable that the quantity found in the plant depends to some extent on the proportion contained in the soil, the duration of vegetation, &c.

We shall later on refer more in detail to this question of titanic acid, and describe some experiments in connection with the different methods of estimating this constituent.

Another interesting point is that the insoluble substance resulting from the action of HCl on the ash does not represent absolutely pure silica. Dr. Maxwell has drawn attention to this when he examined the insoluble matter in the ash of leaves. He showed that there is still a trace of various elements in the ash, and that the residue does not consist of more than 86 to 93 % of silica.

The following is an analysis of insoluble matter from the leaves, tops and dead canes of the *Purple Louisiana* cane:—

Silica	89·72	Alumina	—
Acid, Titanic	0·59	Manganese oxide ..	0·19
,, Phosphoric ..	0·46	Lime	2·48
,, Sulphuric ..	0·94	Magnesia..	1·34
Chlorine..	—	Sodium..	0·72
Oxide of iron	0·63	Potash	2·91

In the course of our experiments we also examined the residue insoluble in acids and found:—

Silica, pure soluble in alkali	82·7
Sand and insoluble silica	11·8
Titanic acid..	0·3
Lime..	0·1
Alkali	2·4
Peroxide of iron	2·6

For specially accurate work, it is necessary to treat this residue with carbonate of potash to find the real silica, and the other elements other than potash and soda; and another portion with carbonate of lime in order to estimate the potash and soda. But the method generally followed amply suffices for the study of the mineral composition of the sugar cane, either of the stem or of the leaves.

Although the average mineral composition of 13 samples of Haiti canes (stalks) agrees with our analyses of Egyptian canes as shown in the table on a previous page, we do not think that this composition can be admitted to be free from error. To begin with if we examine in detail the 13 samples of Dr. Maxwell's we shall find as he has remarked that the elements have varied as follows:—

Silica	14·66 to 32·16	Alumina (?) ..	2·13 to 13·04
Acid, Phosphoric	5·10 ,, 9·12	Lime	2·82 ,, 5·29
,, Sulphuric.	2·61 ,, 10·55	Magnesia	2·34 ,, 6·38
Chlorine	4·43 ,, 14·37	Potash	28·11 ,, 40·08
Oxide of Iron ..	3·25 ,, 7·43	Soda	2·07 ,, 4·36

These variations are considerable, especially in the case of chlorine, sulphuric acid, silica, oxide of iron and alumina. Are they due to the same variety of cane, or to some other cause capable of modifying the mineral composition of the canes? For an answer we might turn to some old analyses of canes in Martinique by Rouff. The latter has shown that from the same cause the mineral composition varies considerably, according to the period of vegetation, not only as regards percentage of ash in the cane, but even in the composition of the ash, so that he concludes:

1. After certain months of vegetation the plant is saturated with alkaline chlorides which are subsequently eliminated in greater part during maturity.

2. There is a period when the cane has absorbed the minimum of mineral matter, of which one part is afterwards eliminated by passing up to the leaves, and another part returns to the soil.

Bonâme has examined the composition of different canes of the same variety, but at different stages of maturity, and has recorded the following interesting results.

Date of planting, March, 1880:—

	Canes Analysed on Feb. 4th, 1881. 1	March 15th, 1881. 2	April 27th. 1881. 3
Weight of leaves	0·727	0·734	0·640
Weight of stems	0·925	1·520	1·781

The cane ash had the following composition:—

	1	2	3
Silica	29·79	33·71	43·40
Acid, Phosphoric	11·38	9·56	12·67
,, Sulphuric	9·62	6·54	8·27
Chlorine	4·76	3·33	0·29
Lime	5·26	7·64	10·26
Magnesia	3·94	7·33	14·15
Potash	34·39	28·00	9·84
Sodium	0·42	3·06	traces
Iron Oxide	0·44	0·73	1·13

It is clearly apparent what a considerable difference exists between these three analyses of the same variety of cane, when made at different stages of maturity.

(To be continued.)

ON TREATING PLANT TOPS AND CUTTINGS WITH GERMICIDES BEFORE PLANTING.

In the Report for 1902-3 on Sugar Cane Experiments in the Leeward Islands, there were recorded the results of a series of experiments on the treatment of cane cuttings with germicides before planting.

These results were of a decisive character, tending to prove that the use of Bordeaux mixture is a very efficacious agent in preserving cuttings while in the soil, thus largely decreasing the number of cuttings which fail to grow. The effects were much more marked in the case of cuttings* than of tops, for in the latter case so large a proportion usually grow that the effect of the germicide is not so marked.

It was decided to repeat the main features of these experiments; accordingly a series of (*a*) tops and (*b*) cuttings was treated as follows:—

* "Cuttings" refer to pieces of the stem of the cane which do not include the main growing point. Those portions which include the main point are referred to as "tops."

1. Untreated.
2. Treated with Bordeaux mixture.
3. Ends tarred.
4. Treated with Bordeaux mixture and ends tarred.

The canes were all planted in a similar manner, *i.e.*, nearly vertically with the ends covered, which is the method commonly followed in these islands. No attempt was made to continue the comparisons between this method of planting and the two others also adopted last year, namely, leaving the ends uncovered and planting flat.

The following table briefly describes the experiments which were undertaken and the results obtained.

EXPERIMENTS WITH TOPS.

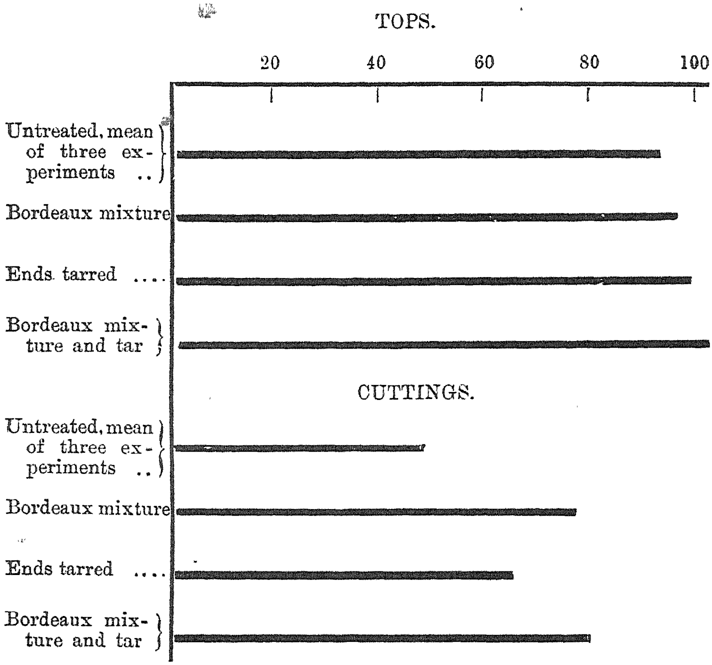
Row.	How Treated.	Holes.	Number Growing. 2nd Week.	3rd Week.	4th Week.	5th Week.	6th Week.	Per cent. Growing.
1	Cane Tops, untreated	100	4	76	92	95	96	96
2	,, Bordeaux mixture.	100	14	84	93	97	98	98
3	,, untreated	100	18	89	96	96	97	97
4	,, ends tarred	100	1	69	92	99	99	99
5	,, untreated	100	18	74	89	92	92	92
6	,, Bordeaux mixture and tar	100	14	94	97	99	100	100

EXPERIMENTS WITH CUTTINGS.

7	Pieces of Cane, untreated ..	100	..	24	24	39	44	44
8	,, Bordeaux mixture.	96*	..	37	45	70	75	78
9	,, untreated	97*	..	7	29	57	52	53·6
10	,, ends tarred	98*	..	93	23	55	64	65·3
11	,, untreated	100	..	10	28	38	48	48·0
12	,, Bordeaux mixture and tar	98*	..	23	51	76	78	79·5

The results are more striking if shown in diagrammatic form as follows, the diagrams giving the position of affairs in the sixth week after planting, the length of line being proportional to the number of plants growing:—

* Space did not permit of the planting of the full 100.



Planting took place on January 16th, 1904, and the number of growing plants was checked weekly from the second week after planting up to the sixth week, when observations were discontinued.

The rainfall for the six weeks under experiment was 3·31 in., as follows: 1st week, 1·27 in.; 2nd week, ·62 in.: 3rd week, ·60 in.; 4th week, ·47 in.; 5th week, ·05 in.; 6th week, ·30 in. This rainfall was eminently favourable for plant growth, being much more favourable than that of the former experiment, hence the cuttings had a much better chance of growing in this season than they had in the former one.

Again this year there is at once made evident the striking superiority of "tops" over cuttings. The large proportion of "tops" which grew in each case left little margin for the action of the germicides to be made apparent, though even here some small gain is shown. In the case of cuttings, we again obtain results of a definite character. A far larger proportion of the treated cuttings grew than was the case with the untreated.

Bordeaux Mixture.—This agent has again exercised a most beneficial effect. As a result of its use the percentage of plants grown from cuttings has been increased by 62 per cent.

Tarring the Ends.—This has had a beneficial effect, though less marked than in the case with the Bordeaux mixture. In this case the percentage of plants growing from cuttings has been increased by 34 per cent.

Bordeaux Mixture and Tarring the Ends.—This treatment has produced results which are very slightly better than those obtained from the use of Bordeaux mixture alone. The percentage of plants growing from cuttings has been increased by 64 per cent.

In practice, therefore, it will be found serviceable to treat all portions of canes used for planting with Bordeaux mixture; this is more efficacious, cheaper, and more easily effected than treating the ends with tar. The slight gain in the use of tar in conjunction with Bordeaux mixture does not warrant the expense of its use.

As the result of these experiments, we can endorse the conclusion arrived at on the former occasion, that Bordeaux mixture when used alone is an efficacious agent in preserving cane tops and cuttings until they germinate; that the treatment is particularly useful where cuttings are employed and a high mortality may be looked for; and that this treatment will probably be useful when drought may be feared, or where canes are planted in areas liable to fungoid attack.

Bordeaux mixture is now being used fairly extensively in this connection in Antigua, and there seems good reason to believe that it is proving of service in those cases where canes are being planted in spots liable to the attack of "root" disease (*Marasmius*).

Note:—Bordeaux mixture is best prepared by the following formula:—

Copper sulphate (blue stone)	6 lbs.
Unslaked lime	4 lbs.
Water..	50 gallons.

The 6 lbs. of copper sulphate (blue stone) are dissolved in 25 gallons of water in a *wooden* tub or barrel; at the same time 4 lbs. of freshly-burnt unslacked lime are slowly slacked and the resulting paste made up to 25 gallons with water, and well stirred. Next the lime-wash and solution of blue stone are slowly poured together into a third tub or barrel holding from 50 to 60 gallons. When the mixing is complete, the blue liquid is stirred for a minute and tested by placing therein a clean knife-blade for one minute. If the knife-blade remains bright the Bordeaux mixture is safe, but if it becomes covered with a deposit of copper, more milk of lime must be added until this deposit ceases to form. Prepared in this way the blue substance in the mixture does not settle readily, and the mixture does not require much stirring before use. (From *Report on Sugar Cane Experiments in the Leeward Islands, 1903-4.*)

PRINCIPLES RELATING TO LOSSES IN BEET SUGAR FACTORIES.

By Dr. H. Claassen.

1. By *total loss* in beet sugar manufacture is meant the difference between the sugar introduced into the factory in the beets, and the sugar obtained in the final products. (1st. sugar, and 2nd massecuites, or all sugars and final molasses.) The beets should be accurately weighed, no deduction being made for moisture, &c., adhering. Their sugar-content should be determined in carefully selected samples of chips, either by hot water digestion, or by alcoholic extraction, according to well-known directions.

Note.—The losses in sugar which beets undergo previous to being weighed in the factory (*i.e.*, during storage, hydraulic transport and washing) should not be counted as manufacturing losses.

2. *Determinable losses* comprise all losses of sugar in the residues and wash-waters, and the quantity and sugar-content of these should be estimated with great care, namely, the exhausted pulp, diffusion water, filterpress cakes, condensed water, and the ammoniacal waters.

3. The undetermined loss is the difference between the total loss (1) and the determinable loss (2).

The undetermined loss can be partially accounted for as follows:—Mechanical losses; those arising from "full weights" when the sugar is bagged; inversion during reheating, and evaporation, &c. But in the present state of our knowledge, these losses cannot be determined with even approximate accuracy, and are considered as capable of explanation, although not of quantitative measurement.

4. Seeing that errors in sampling and analysis of beet chips vary within the limits of 0·1 to 0·2% at least, and that other sources of error exist in the sampling and analysis of final products and residues, it is clearly impossible to determine the total loss, and consequently also the undetermined loss, within closer limits than 0·1 to 0·2%. Having regard to the imperfections in the analytical method, differences of 0·3% should be considered as within the limits of possible and admissible error.—(*La Sucrerie Belge.*)

THE WORKING UP OF AFTER-PRODUCTS.

In the working up of after-products the tendency of the resulting mother syrups to hinder crystallisation is not only very appreciable, but even goes so far as to confine the effects of this work within certain limits. It is, therefore, of great interest to ascertain what is the most suitable water-content for the boiled masse-cuite to possess at the moment of drawing off, in order, other necessary conditions holding good, to count on a favourable crystallisation. Just as it is bad to reckon on a surplus of water, since correspondingly more sugar will remain in solution, it is not less a mistake to work with too great a concentration, for it is well known then that the supersaturated and proportionately viscous syrups hinder the after-crystallisation from an early point, and place considerable difficulty in the way of further working up the masse-cuite. The question of the water content easily admits of a theoretical answer, and yet an answer of no value in certain special cases which I will shortly point out.

Since the whole of the working up of after-products as far as the centrifugalling is nothing else than a crystallisation process, the question has to be settled, under what circumstances is this process best carried out.

This is decidedly the case when there is present in the uncentrifugalled masse-cuite, besides the crystals, a saturated sugar solution corresponding to the temperature and purity concerned; if likewise, in the resulting mother syrup the mass of sugar present in it is equal to the water content multiplied by the figure of saturation of the requisite syrup; thus—

$$Z = \text{Water} \times s$$

or by using the molasses coefficient and the amount of non-sugar in the masse-cuite—

$$NZ \times m = \text{Water} \times s$$

where

s = saturation figure of the mother syrup according to its temperature and purity,

m = coefficient of molasses,

NZ = non-sugar in the masse-cuite.

Further, let Q = Purity of the masse-cuite.

The water content of the masse-cuite according to the above formula would be

$$\text{Water} = \frac{NZ \times m}{s}$$

In order therefore to estimate at once in a masse-cuite of known purity the water content according to the above proportions, we can use the formula—

$$\% \text{ Water} = 100 \frac{(100 - Q)\, m}{s} \div 100 + \frac{(100 - Q)\, m}{s}$$

As the above example shows, the co-efficient of saturation of the treated mother syrups is necessary for this calculation.

Now, in the sugar industry it is not possible to work up syrups of equal composition, for both the material and the details of work vary with every place; furthermore, the quantity and quality of the non-sugar, as well as its influence on the solubility, varies much, and has been as yet little studied. It is, therefore, evident that no tables of solubility of impure syrups, wherever their origin, can be counted of general value; the figures can only be relied on for purposes of comparison.

In this respect the writer has made use of the tables of Fradiss, but employing them solely for comparative research.

The following calculation is made with runnings of 60 purity, at a temperature of 55° C. In this case m equals 1·5 and s 3·61.

In calculating the water content of a masse-cuite of 75 purity, we then obtain—

$$100\ \frac{(100-75)\ 1{\cdot}5}{3{\cdot}61} \div 100 + \frac{(100-75)\ 1{\cdot}5}{3{\cdot}61}$$
$$= \frac{103800}{11038} = 9{\cdot}4\%\ \text{water.}$$

The composition of the masse-cuite was thus—

Sucrose .. .. .. 90·6.
Polarisation .. .. 67·95; 90·6—67·95 = 22·65 non-sugar.
Quotient of Purity .. 75.

$$22{\cdot}65 \times 1{\cdot}5 = 33{\cdot}975 \text{ syrup sugar.}$$
$$33{\cdot}975 \div 9{\cdot}4 = 3{\cdot}61$$
$$3{\cdot}61 = s$$

On the basis of a running of 60 purity at a temperature of 55°C. the water content is as follows for different purities:—

Purity.	Water. Per cent.	Purity.	Water. Per cent.	Purity.	Water. Per cent.
80	7·67	76	9·06	72	10·41
79	8·00	75	9·40	71	10·75
78	8·37	74	9·74	70	11·07
77	8·71	73	10·08		

The writer deems that it is not without interest by means of the above example to throw some light on the behaviour of a masse-cuite which is run off with different water contents.

The masse-cuite had a purity of 75, care being taken that a running of 62 purity was obtainable; and masse-cuites with the following water contents were drawn off:—

1.—With 9·4% water.
2.— ,, 8% ,,
3.— ,, 7% ,,

Case 1.—A masse-cuite of the following composition: sucrose, 90·6; polarisation, 67·95; purity, 75; 90·6—67·95 = 22·65 non-sugar, occurred, and 22·65 × 1·63 = 36·92 syrup sugar.

With a molasses coefficient of 1·63 a running was obtained having a supersaturation of 1·09.

The masse-cuite had thus, previous to centrifugalling, the following percentage composition:—

31·03	crystals.		
36·92	syrup sugar		Sucrose .. 86·3
22·65	non-sugar .	68·97 =	Polarisation 53·5
9·40	water.. ..		Purity .. 62
100·00			

$$53{\cdot}5 \div 13{\cdot}7 = 3{\cdot}9 \quad (m)$$
$$3{\cdot}9 \div 3{\cdot}55 = 1{\cdot}09 \ (s)$$

The last figure is, according to Claassen (who considers a supersaturation of 1·25—1·02 as the most favourable for crystallisation), high enough to make certain, with full crystallisation, of a running of 60 purity without working with too great a supersaturation.

2.—Masse-cuite with 8% water drawn off gave sucrose, 92; polarisation, 69; quotient of purity, 75. Whence $92 - 69 = 23 \times 1{\cdot}63 = 37{\cdot}49$ syrup sugar.

35·51	crystals.		
37·49	syrup sugar		Sucrose .. 88·3
23·00	non-sugar .	68·49 =	Polarisation 54·7
8·00	water.. ..		Purity .. 62
100·00			

here we have a running with a molasses quotient of $54{\cdot}7 \div 11{\cdot}7 = 4{\cdot}67$, from whence we find $4{\cdot}67 \div 3{\cdot}55 = 1{\cdot}3$ supersaturation.

3.—Masse-cuite with 7% water gave sucrose, 93; polarisation, 69·75; purity, 75. $93 - 69{\cdot}75 = 23{\cdot}25 \times 1{\cdot}63 = 37{\cdot}9$ syrup sugar.

31·85	crystals.		
37·90	syrup sugar		Sucrose .. 89·7
23·25	non-sugar .	68·15 =	Polarisation 55·6
7·09	water.. ..		Purity .. 62
100·00			

We get from this a running with a molasses quotient of $55{\cdot}6 \div 10{\cdot}3 = 5{\cdot}39$, whence $5{\cdot}39 \div 3{\cdot}55 = 1{\cdot}51$ supersaturation.

In cases 2 and 3 it must be observed that these were worked with decidedly too great a supersaturation; and since this causes delay to the process owing to after-crystallisation through addition of centrifugal runnings, it only results, apart from all other bad propensities of strongly supersaturated mother syrups, in a prolongation of the centrifugal work.—(C. Mrasek in *Oester-Ungarische Zeitschrift.*)

CONSULAR REPORTS.

Hungary.

Table showing Sugar Production in Hungary for the years 1897-8—1901-2:—

Year.	No. of Factories.	Amount in Quintals of Sugar produced.
1897-98	20	2,030,455
1898-99	20	2,467,806
1899-1900	20	2,504,501
1900-01	20	2,877,552
1901-02	20	2,627,745

France.

Havre.—The price of sugar has risen very considerably in the past year. The suppression of the bounties on exports and the bad crops of beetroot brought about a rise in prices. The following were the prices in the French sugar market:—January, 1904, 24 fr. 37 c. (19s. 6d.); February, 24 fr. 28 c. (19s. 5½d.); March, 25 fr. (£1); May, 25 fr. 34 c. (£1 0s. 3½d.); October, 26 fr. 50 c. (£1 1s. 2½d.); December, 42 fr. 15 c. (£1 13s. 9½d.); January, 1905, 43 fr. 62 c. (£1 15s. 1d.); and February, 42 fr. (£1 13s. 8d.).

Nantes.—The quantities of cane sugar imported into Nantes during the last three years have been as follows:—1902, 47,320 tons; 1903, 44,777 tons; 1904, 33,713 tons. It all came from the French West Indies and Egypt.

Russia.

Poland.—The British Consul-General reports:—The long drought during the summer of 1904 did even more harm to the beet than the continuous rains in 1903. The consequence was a very short crop, which was, however, of exceptionally good quality.

The average yield per acre was 108 cwts., which is 12 cwts. less than in 1903, and the total yield was only 14,720,276 cwts., which is 1,472,730 cwts. less than in 1903, although the area under beet was 4,437 acres larger, and 20,000,000 cwts. are considered an average yield.

Sugar refineries had a bad year in consequence, and several of them will pay no dividend.

Two new sugar refineries were opened in 1904 in Poland, both in the government of Lublin, the total number of refineries in Poland being now 51, which give employment to 19,160 hands. The average pay for a man is 18 r. per month, for a woman 7 r. per month, and for a child 5 r. per month.

Poland comes next to Kieff in importance as a sugar-producing district in Russia, and exports to the Far East, Persia and Finland, as well as abroad.

Formerly sugar, especially from the Kieff district, was chiefly exported to the United Kingdom through Odessa, but latterly exporters have found it more profitable to export through Dantzig, whence the cheap sea freights make the carriage come cheaper than by the southern route. Besides this, the German railroads and shipping companies give advances on sugar in transit which are not obtainable on sugar shipped from Odessa.

SPAIN.

The high price of sugar prevailing in Europe and America has had the effect of causing greater attention to be given to the possibilities which would attend the better and more economical cultivation of beet and cane in the country.

Factories and plantations are, unfortunately, very much scattered over Spain, but the most important are situated in Arragon and Granada.

The amalgamation of the various sugar factories under the title of Sociedad General Azucarera de Espana, was carried out in September, 1903, with the object of preventing the complete ruin of an industry which, considering the value of its bye-products and its intimate connection with agriculture, could be developed into an important enterprise.

During 1904 cane cultivation produced 136,000 tons gross weight, whilst the company expects to place some 55,000 tons of beet sugar on the market during the season 1904-05.

TURKEY.

Constantinople.—Sugar to the amount of 89,606 tons and valued at £956,000 was imported into Constantinople from Austria in 1903, while in 1904 the amount was over 98,000 tons.

CHINA.

Chinkiang.—Sugar, foreign and native, is a very important article of import as the following figures show :—

	1904.		1903.	
FOREIGN.	Cwts.	£.	Cwts.	£.
Sugar, brown ..	452,923	217,969	364,411	147,414
,, candy ...	25,418	21,866	22,510	20,824
,, refined ...	133,800	86,121	130,192	78,423
,, white	148,670	87,646	126,708	78,565
NATIVE.				
Sugar, brown	95,916	46,505	106,794	43,673
,, candy	2,900	2,867	2,587	2,402
,, white	91,881	65,774	77,481	48,813

Native sugar shows a slight increase, but it will never regain its supremacy of some four or five years ago, when it exceeded the foreign import. It is necessary, however, to repeat the yearly explanation that a good proportion of the so-called foreign sugar is

really native sugar from the southern provinces, which is passed through Hong-Kong in order to make it "foreign," and thus enable it to take advantage of the transit pass system in the course of its distribution from the Chinkiang centres.

Kiungchow.—The exports of sugar during the last few years have been as under:—

	Average 5 years, 1899-1903. Cwts.	1903. Cwts.	1904. Cwts.
Brown sugar	175,744	130,233	154,065
White ,,	18,465	627	11,146

Argentina.

Buenos Aires.—The exports of sugar in 1904 showed a decrease of 12,000 tons; in fact the figures for the past four years show progressive decrease.

There are 51 sugar-boiling factories in the provinces of Jujuy and Tucuman; and 131 distilleries which employ sugar, wine or grain in their processes. Some of the largest of the latter have closed down, as it was found impossible to work at a profit in consequence of heavy taxes.

Nicaragua.

Sugar cane is cultivated in all the districts of the Republic, and there are several sugar factories equipped with the most modern machinery, one of which, situated near Chinandega and owned by a British company, will compare favourably, in methods both of cultivation and preparing the sugar, with the best factories of any country.

There are two classes of sugar used; one called "dulce" and made by the small planters, consists simply of the juice of the cane, extracted frequently with a native-made wooden sugar mill driven by oxen, boiled in large caldrons and formed into loaves by pouring the crystallised juice in deep round holes bored in a big trunk of a tree. This class of sugar is of a very dark colour and full of impurities but rich in saccharine matter. The best equipped factories produce an excellent class of refined sugar, principally by the vacuum pan system.

Nearly the whole of the sugar is consumed in the country, but no returns can be obtained of the amount made. In the year 1903 there were exported 7,734 cwts. of sugar, valued at £3,173, of which 3,800 cwts. went to the United States of America, 3,700 cwts. to Honduras and 90 cwts. to each of the Republics of Columbia and Chile. The sugar shipped to the United States of America went to San Francisco, California, but it is understood that the expenses incurred were too heavy to make the shipment profitable.

Several of the sugar factories are also equipped with distilleries for making "aguardiente" or native rum and alcohol. The sale of these spirits is a monopoly of the Government, who buy the spirits from the distilleries and sell it to the consumer. According to the returns of

the Minister of Finance the following revenue was derived from the monopoly of spirits:—

	Quantity. Litres.	Value. Currency. Dollars.	Sterling. £
Aguardiente	948,406	1,177,284	39,242
Alcohol	10,975	43,597	1,453
Total ..	959,381	1,220,881	40,696
Mixed liquors prepared from alcohol	..	21,334	711
Sale of licences and monopoly on the Atlantic coast ..	..	78,755	2,625
Grand total ..	959,381	1,320,970	44,032

The Nicaraguan Government have, from January 1, 1904, and for the term of six years, rented the monopoly of the sale of native spirits to a syndicate formed of the owners of the four principle distilleries for the sum of 1,341,000 dol. (£44,700) for each of the first two years, and 1,420,000 dol. (£47,333) for each of the four following years.

Correspondence.

To the Editor of "The International Sugar Journal."

Dear Sir,—There was a little slip in your account of the new Central Factory at Antigua in the February issue of your Journal, on p. 55. You state that the payment for canes bought from peasants (or farmers) is not to exceed 7s. 6d. per ton, whereas the opposite is the case: 7s. 6d. being the *minimum* price to be paid for peasants' canes.

2. The following are the actual prices paid so far:—

	Per Ton. s.	d.
To March 4th	13	3
March 6th to March 18th..	12	8½
March 20th to April 1st	13	9½

3. I am pleased to be able to inform you that the new factory is working very satisfactorily.

Yours very truly,

Francis Watts,

Govt. Chemist and Supt. of Agriculture.

Government Laboratory for the Leeward Islands,
Antigua, April 19th, 1905.

FIVE-ROLLER MILLS.

To the Editor of "The International Sugar Journal."

Dear Sir,—We notice in your "Sugar Journal" for this month, that on p. 225, under the heading of "Modern Sugar Machinery," the writer mentions the matter of five-roller Mills and states that Messrs. John McNeil & Co. are the makers of this Mill from their own design, also that Messrs. John McNeil & Co. three years ago introduced the first five-roller Mill into Jamaica. To keep your readers right in this matter we beg to intimate that our Company, when under the title of W. & A. McOnie, were the original makers of the five-roller Mill, and the first five-roll Mill was constructed by us in the year 1881, before Messrs. McNeil's firm was in existence. In the year 1890 there was an International Exhibition held in Jamaica, and at that Exhibition we exhibited a five-roller Mill for which we were awarded a Gold Medal, so that we were also the introducers of the five-roller Mill to Jamaica—and that twelve years before Messrs. McNeil had supplied their five-roller Mill to that island.

The insertion of this letter in your valuable Journal will much oblige.

Yours truly,

For Harvey Engineering Co., Limited
(Late McOnie, Harvey & Co., Ld.),
Wm. McIntosh, Director.

Glasgow, 19th May.

MONTHLY LIST OF PATENTS.

Communicated by Mr. W. P. Thompson, C.E., F.C.S., M.I.M.E., Chartered Patent Agent, 6, Lord Street, Liverpool; and 322, High Holborn, London.

ENGLISH.—Applications.

8352. J. Harvey, Glasgow. (Communicated by R. Harvey, West Indies.) *Improvements in and relating to appliances for treating crushed cane or megass.* 19th April, 1905.

8451. T. Jameson, London. *Improvements in the manufacture of saccharine (ortho-toluene sulphimide.)* 20th April, 1905.

8661. R. J. Thomas & W. F. S. Howe, London. *An improved method of clarifying juices in the manufacture of sugar.* 22nd April, 1905.

8859. J. McNeil, Glasgow. *Improvements in dumbturners for sugar-cane mills.* (Complete specification.) 27th April, 1905.

9137. H. Roy, London. *Improvements in and relating to apparatus for the treatment of masse-cuite.* (Date applied for under Patents Act, 1901, 2nd May, 1904, being date of application in France.) Complete specification. 1st May, 1905.

159413. Heinrich Korán, of Meziric, Bohemia. *A sugar loaf press.* 26th April, 1904. This invention relates to a sugar loaf press in which the moulding is operated by means of two dies, moved by screw spindles which are located above and beneath a mould mounted on a revoluble shaft, the upper die or punch being moved in a removable cylindrical guide and serving for compressing the mass of sugar in the mould, whilst the under die or matrix is provided with a conical recess and extends into the mould with the object of forming the point of the sugar loaf.

159350. Tozaburo Suzuki, of Sunamura, Province of Tokio, Japan. *An apparatus for concentrating sugar juice and the like.* 9th February, 1904. In this apparatus for concentrating sugar juice and the like by means of two or more pans connected with one another by steam and feed pipes, the evaporation takes place in concentric dishes inserted one in another and formed as annular open trays, by trickling over closed heating pipes lying concentrically in them by means of distributing plates rotating above the heating pipes and provided with concentrically arranged holes. In a modified form of the apparatus the trickling apertures in the distributing plates are each provided with an overflow edge, with the object of enabling the fluid to drop down uniformly, during the rotation of the distributing plates, on to the closed walls of the heating pipes. In a further modification of the apparatus the steam evolved, owing to the evaporation of the trickling fluid, is thrown off through the annular spaces formed by the inner flanges of the distributing plates and the pans, and through the shaft which carries the distributing plates and which is made hollow with the object of not affecting the uniform sprinkling of the heating pipes.

159088. Wilhelm Heinrich Uhland, of Leipzig-Gohlis. *An apparatus for the continuous separation of starch in a highly concentrated condition from water or residuals.* 14th September, 1902. This apparatus for the continuous separation of starch in a highly concentrated condition from water or rather residuals, by diminishing the speed and lateral diversion of the liquid introduced into the apparatus by means of a vertical pipe, consists of a cylindrical or rectangular upper part, a conical under part, a horizontal feed pipe lying under the level of the liquid which opens into the enlarged part of the vertical inlet pipe; chambers communicating with preferably adjustable overflows in order to gradually operate a diminution of the speed and lateral diversion of the liquid, whilst suitably regulating its discharge, and of a discharge arrangement of sufficient width and adapted to be rapidly closed for rapidly letting off the starch when separated out in a highly concentrated condition. An improvement in the discharge arrangement of the above apparatus consists of a tap of large diameter and large aperture of passage, a

toothed segmental wheel, gearing, handwheel, lock spring or pawl, and a lower discharge aperture of greater diameter than the opening in the upper passage.

159351. W. H. UHLAND, of Leipzig-Gohlis. *A straining apparatus for washing starch out of materials containing starch.* 17th December, 1903. This improved straining apparatus for enabling starch to be washed out of disintegrated starchy materials, is characterised by a combination, the straining bodies or sieves having a circular movement and being arranged in sets.

159715. TADEUSS VON LEWICKI, Warsaw. *A method of disinfecting the diffusion of beetroot shreddings.* 14th June, 1903. This method of disinfecting the diffusion liquor of beetroot shreddings is characterised by the antiseptic washing liquid added to the fresh shreddings in the fresh-filled diffuser, and, if desired, produced with this diffuser, being forced into the succeeding diffuser freshly filled with shreddings without leaving the battery finally before the exhaustion of its disinfecting action, so that the quality of antiseptic necessary for disinfection only requires to be supplemented from time to time.

159742. JOSEF KRIVANEK, Kiew. *A method of expelling the green syrup and the casing syrup in making slabs, strips, or blocks of sugar masse-cuite by means of suction.* 14th August, 1903. This method of expelling the green syrup and the casing syrup in making slabs, strips, or blocks of sugar masse-cuite by means of suction, consists in the green syrup and casing syrup being each time expelled from the sugar masse by suction by means of moistened air before a better casing material is commenced to be added or is introduced, with the object of preventing crystallisation of the green syrup and the casing syrup inside the sugar masse during the operation of suction.

159847. JOSEF KRIVANEK, Kiew. *A method of drying sugar in slabs, strips, or pieces.* 14th August, 1903. This method of drying sugar in slabs, strips or pieces, consists in the sugar slabs or the like being arranged in superimposed layers alternately with metal plates and dried in this position by the action of heat.

NOTE.—Copies of all published specifications with their drawings in these lists can be obtained from W. P. Thompson & Co., 6, Lord Street, Liverpool, at One Shilling a copy for English or American Patents, and Two Shillings for German. In ordering please give number and date.

IMPORTS AND EXPORTS OF SUGAR (UNITED KINGDOM)

To end of April, 1904 and 1905.

IMPORTS.

Raw Sugars.	Quantities.		Values.	
	1904. Cwts.	1905. Cwts.	1904. £	1905. £
Germany	2,315,978	780,219	993,685	556,982
Holland	64,621	74,389	25,597	54,731
Belgium	91,822	267,706	36,551	202,018
France	86,964	45,967	38,592	35,799
Austria-Hungary	593,670	210,908	269,101	157,356
Java	685,023	1,079,222	290,781	819,546
Philippine Islands	....	....	....	....
Cuba	....	....	....	....
Peru	289,296	559,248	127,736	421,933
Brazil	75,266	24,974	28,747	16,657
Argentine Republic	....	....	....	....
Mauritius	158,680	111,623	59,258	63,142
British East Indies	44,348	118,253	18,656	62,349
Br. W. Indies, Guiana, &c.	363,031	491,983	233,926	433,357
Other Countries	249,790	368,542	113,778	279,739
Total Raw Sugars	5,018,489	4,133,034	2,236,408	3,103,609
Refined Sugars.				
Germany	3,326,908	2,950,160	1,845,489	2,554,150
Holland	1,059,564	454,481	617,684	405,508
Belgium	136,053	104,976	75,902	92,159
France	805,487	387,769	69,726	339,338
Other Countries	156,953	181,789	82,845	151,560
Total Refined Sugars	5,484,965	4,079,175	3,051,646	3,542,715
Molasses	520,213	760,489	97,072	165,381
Total Imports	11,023,667	8,972,698	5,385,126	6,811,705

EXPORTS.

British Refined Sugars.	Cwts.	Cwts.	£	£
Sweden and Norway	7,765	7,391	4,441	6,285
Denmark	40,858	21,700	20,962	17,439
Holland	19,434	24,682	10,190	21,076
Belgium	3,412	1,686	1,905	1,326
Portugal, Azores, &c.	3,180	5,166	1,762	4,200
Italy	1,727	394	810	320
Other Countries	104,542	69,309	64,671	66,651
	180,918	130,328	104,741	117,297
Foreign & Colonial Sugars.				
Refined and Candy	7,721	5,596	5,500	5,558
Unrefined	34,786	14,430	19,005	12,161
Molasses	94	403	37	193
Total Exports	223,519	150,757	129,288	135,209

UNITED STATES.

(Willett & Gray, &c.)

(Tons of 2,240 lbs.)	1905. Tons.		1904. Tons.
Total Receipts, Jan. 1st to May 18th ..	772,013	..	782,662
Receipts of Refined ,, ,, ,, ..	648	..	125
Deliveries ,, ,, ,, ..	708,539	..	772,268
Consumption (4 Ports, Exports deducted) since 1st January	580,810	..	654,232
Importers' Stocks (4 Ports) May 17th ..	57,414	..	22,555
Total Stocks, May 24th	277,000	..	204,887
Stocks in Cuba, May 24th	362,000	..	227,332
	1904.		1903.
Total Consumption for twelve months ..	2,727,162	..	2,549,643

CUBA.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1904 AND 1905.

(Tons of 2,240lbs.)	1904. Tons.		1905. Tons.
Exports	637,070	..	550,449
Stocks	266,915	..	385,238
	903,985	..	935,687
Local Consumption (four months)	15,000	..	15,130
	918,985	..	950,817
Stock on 1st January (old crop)	94,835	..	—
Receipts at Ports up to April 30th	824,150	..	950,817

Havana, 30th April, 1905. J. GUMA.—F. MEJER.

UNITED KINGDOM.

STATEMENT OF IMPORTS, EXPORTS, AND CONSUMPTION FOR FOUR MONTHS ENDING APRIL 30TH.

SUGAR.	Imports. 1903. Tons.		Imports. 1904. Tons.		Imports. 1905. Tons.	Exports (Foreign). 1903. Tons.		Exports (Foreign). 1904. Tons.		Exports (Foreign). 1905. Tons.
Refined	271,820	..	274,248	..	203,595	407	..	384	..	280
Raw	182,234	..	250,924	..	206,652	764	..	1,739	..	721
Molasses	25,446	..	26,011	..	38,024	9	..	5	..	20
Total..........	479,500	..	551,183	..	448,635	1,180	..	2,130	..	1,021

	Home Consumption. 1903. Tons.		1904. Tons.		1905. Tons.
Refined	252,364	..	292,711	..	195,190
Refined (in Bond) in the United Kingdom	—	..	172,758	..	158,213
Raw	170,515	..	42,499	.	29,278
Molasses	25,959	..	26,320	..	37,827
Molasses, manufactured (in Bond) in U.K.	—	..	21,601	..	17,718
Total	448,838	..	555,889	..	438,226
Less Exports of British Refined....................	10,811	..	9,046	..	6,516
Total Home Consumption of Sugar	438,027	..	546,843	..	431,710

STOCKS OF SUGAR IN EUROPE AT UNEVEN DATES, MAY 1ST TO 24TH, COMPARED WITH PREVIOUS YEARS.

IN THOUSANDS OF TONS, TO THE NEAREST THOUSAND.

Great Britain.	Germany including Hamburg.	France.	Austria.	Holland and Belgium.	TOTAL 1905.
177	792	494	386	96	1946

	1904.	1903.	1902.	1901.
Totals	2550 ..	2523 ..	2631 ..	1846

TWELVE MONTHS' CONSUMPTION OF SUGAR IN EUROPE FOR THREE YEARS, ENDING APRIL 30TH, IN THOUSANDS OF TONS.

(Licht's Circular.)

Great Britain.	Germany.	France.	Austria.	Holland, Belgium, &c.	Total 1904-5.	Total 1903-4.	Total 1902-3.
1665	1043	655	464	178	4005	3951	3363

ESTIMATED CROP OF BEETROOT SUGAR ON THE CONTINENT OF EUROPE FOR THE CURRENT CAMPAIGN, COMPARED WITH THE ACTUAL CROP OF THE THREE PREVIOUS CAMPAIGNS.

(From Licht's Monthly Circular.)

	1904-1905. Tons.	1903-1904. Tons.	1902-1903. Tons.	1901-1902. Tons.
Germany	1,575,000 ..	1,927,681 ..	1,762,461 ..	2,304,923
Austria	893,000 ..	1,167,959 ..	1,057,692 ..	1,301,549
France	625,000 ..	804,308 ..	833,210 ..	1,123,533
Russia	940,000 ..	1,206,907 ..	1,256,311 ..	1,098,983
Belgium	173,000 ..	203,446 ..	224,090 ..	334,960
Holland	135,000 ..	123,551 ..	102,411 ..	203,172
Other Countries .	340,000 ..	441,116 ..	325,082 ..	393,236
	4,681,000	5,874,968	5,561,257	6,760,356

THE

INTERNATIONAL

SUGAR JOURNAL.

No. 79. JULY, 1905. Vol. VII.

☞ All communications to be addressed to The Editor, Office of *The Sugar Cane*, Altrincham, near Manchester.

All Advertisements to be sent *direct*.

Cheques and Postal Orders to be made payable to Norman Rodger, Altrincham.

☞ The Editor is not responsible for statements or opinions contained in articles which are signed, or the source of which is named.

NOTES AND COMMENTS.

The Naudet Process in the West Indies.

While numerous references to the working of the Naudet Process in the West Indies last season have appeared in the press, little information of an authoritative character has been given. We have now the pleasure of offering to our readers a really reliable account of what the process is, and what it has accomplished at the two usines, *Fortuna* and *Caroni*, where it has just been given a thorough trial. The writer of the article is Mr. Robert Harvey, M.I.M.E., who has been out in the West Indies in conjunction with Mr. Naudet to supervise the working of the process. As his firm were responsible for designing and erecting the machinery, his knowledge of all the details is obviously of a thorough character. There is no doubt that the new process has proved a success; we have examined samples of crystals resulting from it, and they are of the highest class. It is to be hoped that it will ere long be possible to carry on this process in a factory equipped throughout with the most up-to-date machinery in all departments, in which case we shall be in a fair position to compare the new system with the other modern systems in use in Cuba, Java, and the beet sugar area of Europe.

Chemical Control in Sugar Factories.

Amongst several interesting papers to be found in this number is one by Mr. T. H. P. Heriot, F.C.S., who commences a series of articles on simple chemical control. As he points out, it is not desired to encourage the sugar-house manager to dispense with a chemist and undertake the chemical control himself. It is rather with a view to interesting what we may describe as the jack-of-all-trades' manager in the advantages of chemical supervision of a kind which perchance he has not so far troubled to adopt. Once this manager has satisfied himself as to the improved results and increased profits accruing from a more scientific control, he may be encouraged to go a step further and retain the services of a trained chemist. That the latter will more than pay for his cost is a truism which it is difficult for some people to realise; but there is some hope of their conversion when the change is brought about by stages. There may always be here and there sugar establishments, which from their scope and the limited market they serve, cannot afford an expensive staff, but, generally speaking, it is safe to say that the future will see the merging of all small cane sugar establishments of a given district into one whole as a central factory, equipped with up-to-date apparatus and attendants. Only under such conditions can the cane sugar industry hope to retain the natural advantages it possesses over its great rival, the beet industry.

The "*Mackay* Sugar Journal."

We regret to learn that the *Mackay Sugar Journal* has been discontinued as a separate publication. In the words of its proprietors, "the absence of all progress in connection with the sugar industry" in Queensland has forced them to take this step. We are not altogether surprised at their decision. A paper devoted to the needs of a local industry can only prosper if the said industry continues to progress. It is pretty evident that the merging of the Australian States into a Commonwealth, with a resultant parliament largely filled with labour representatives from the small but populous south-eastern corner of the continent, has not tended to aid the Queensland sugar industry. Men living and working in a temperate zone are scarcely competent to understand the needs of an essentially tropical country, and so it comes to pass that the Socialist régime of New South Wales and Victoria with its craze for a "White Australia" only oppresses the Queensland planters. What it will come to, when the Kanakas have all gone back to their island homes, we do not care to prophesy, but we do not think the odds are in favour of progress.

We note that the confectioners of Australia have too a "dear sugar" grievance to air. Thanks to the bounties given for employing white labour only we are told that "in the sugar industry alone Australian

consumers are paying, directly and indirectly, more than £1,500,000 for the 'White Australia' craze." This, however, is a more modest sum than that the British consumer is alleged to have lost by the *abolition* of bounties. Australian and British confectioners are both equally concerned with bounties—one wants *abolition*, the other *restoration*. Personally, we have far more respect for the demands of the Australians.

Retirement of Dr. Stubbs.

The decision of Dr. Stubbs, the eminent sugar expert, to retire from active life in the field of agricultural experimentation will be learnt with regret by all those who directly or indirectly have benefitted by his researches. For twenty years he has been engaged in aiding the Louisiana sugar industry to place itself on a scientific basis, and he has well succeeded. His contributions to sugar literature are to be found in every up-to-date planter's library; in particular his work, "The Sugar Cane." If his retirement is the outcome of a desire for more leisure for writing and study, we may surely hope for some more contributions from his pen at a not distant date.

International Sugar Congress at Brussels.

The Belgian Association of Chemists has arranged for an International Sugar Congress to be held in Brussels from July 5th to 10th, when papers will be read dealing with the chemistry and technology of the sugar works and distillery. Amongst those who will be heard will be M. A. Aulard, Mr. Sigmund Stein, M. Emile Saillard, M. H. Pellet, Dr. Claassen, and others. An interesting and instructive programme has been drawn up, and a visit to the Exhibition at Liége has been arranged to form part of the proceedings.

The 26 sugar factories in the Province of Tucuman dealt with 1,361,076 tons of cane during 1904. The output of sugar to March 31st of the current year was 109,862 tons, the yield ranging from 6·18 to 9·84 per cent. The sales of sugar amounted to 105,431 tons, leaving a stock of 4,431 tons.

Mr. L. Lewton-Brain, B.A., for the last three years Mycologist and Lecturer in Agriculture on the staff of the Imperial Department of Agriculture for the West Indies, has accepted the appointment of Assistant Director of the Pathological Division of the Experiment Station of the Hawaiian Sugar Planters' Association. He should find plenty of scope for his abilities in Hawaii.

THE COBDEN CLUB ONCE MORE.

We always take up a fresh publication from The Cobden Club with the feeling that perhaps this time they may show some signs of dealing with economic questions in the real scientific spirit of dispassionate investigation and demonstration. It is true that hitherto we have been invariably disappointed. More than a quarter of a century has passed since the Editor of *The Spectator* lamented, with regard to the sugar question, that so much heat and passion should be shown about a matter of a purely scientific character and one requiring to be dealt with on scientific principles.

The pamphlet, recently issued by the Club, entitled "The Results of the Sugar Convention," unfortunately gives us no fresh light on the economic aspect of the question. It is, in fact, nothing more than an electioneering document of the very basest sort. Misleading statements, erroneous or distorted inferences, the word Protection with a capital P, fill every page of this wonderful tirade. The first principles of economic science, the most elementary facts about markets and prices, are so completely ignored that we hardly know how to deal seriously with such a burlesque representation of plain commercial truths.

Those truths are so well known to all engaged in the commerce or industry of sugar that we are apt to fancy them to be equally clear to the general public. The Cobden Club know better. They know that the man in the street can be easily misled in matters of this kind, and they proceed to mislead him, with every prospect of success. The sugar trade know that sugar below cost price must result in reduced production and high prices. The Cobden Club entirely disregard this elementary axiom. Their whole argument is based on the assumption that a glut of sugar, with prices 40 per cent. below cost, can be maintained permanently. They forget that humble producers, like other mortals, must earn a living or shut up their works. In the latter case the consumer loses a large portion of his sources of supply and pays the penalty. Whenever he congratulates himself on enjoying a commodity below cost price he is blind to the fact that scarcity and high prices must be the inevitable result. This is the key note of the whole fiscal question. Foreign producers with high protective duties can get such abnormal profits on their own market that they can afford to export their surplus at a loss and yet make abnormal profits on their total output. Thus they can kill outside competition and will, if we permit it, eventually become masters of the situation. First, our producers suffer; but, very soon, the consumer is the victim. Mr. Balfour and Lord Lansdowne object to this and would remedy it. The Cobden Club, on the other hand,

approve, and, in their ignorance, disregard the consequences. They glory in "artificially cheap sugar." They have never given a thought to the inevitable result.

This really knocks the bottom out of their whole contention. The rest of the pamphlet is mere words without a meaning. The same may be said with regard to the whole of the party who erroneously call themselves Free Traders, and who, with eyes shut to this fundamental truth, blindly oppose every attempt to defend producers and consumers against this insidious and most deadly attack upon their just rights and interests. It will be interesting to see whether the truth will prevail. There is no doubt that the Cobden Club will do their best to prevent it. Cobden declared that the only thing he fought for was the natural price. The Cobden Club have now declared categorically that what they aim at is the unnatural price; and they declare that they do so, forsooth, in the interest both of the consumer and the manufacturer. This is, indeed, economic science turned upside down.

The rest is all verbiage; some of it not very polite, as when they speak of "cliques of buccaneering capitalists" and "ex-slave owners." They kindly brand the Convention as "the deliberate effort to make scarce and dear this necessary material which for years had been plentiful and cheap." Cobden would have said that the restoration of the natural price would greatly enlarge the sources of supply. The Club, who take his name in vain, contradict him flatly.

One of the most important acts of the Convention was the large reduction of protective duties on sugar in the principal European countries. A similar policy may eventually reduce all European import duties to a figure which will prevent foreign producers from obtaining abnormal profits on their own markets, and thus render them unable any longer to undersell us either in British or in neutral markets. This will be the ultimate result of tariff reform. The Cobden Club declare that the Convention, in reducing the protective duties to such a figure as will bring about this essential remedy, has caused "England to become not only a consenting but an active party in this rank Protectionism." Here, again, we see the topsy-turvy nature of Cobden Club economics. To make their mistake still worse they add that the Cartels will continue to disturb prices as much as they have done. They are evidently unaware that the reduction of the import duties has had the desired effect, and that the Cartels are a thing of the past.

The pamphlet is full of similar mistakes, and our space is too valuable to correct them all. They speak of Canadian preference as "in direct opposition to the terms of the Convention;" and again, as "contrary to the stipulations of the Convention." There are no such

terms or stipulations. They speak of the United States as the great exporting country, and declare that the rival that the continental countries had to fear was not the West Indies but the United States and its possessions. This is a curious error. The United States consume about 2,300,000 tons of sugar, and produce only about 500,000 tons, all of which enters consumption without paying any duty, and therefore enjoys a preference of about 7s. per cwt. No sane producer in the States would export his sugar and thereby lose 7s. per cwt. The same with regard to the possessions outside the States. They all enjoy a substantial preference in the United States market, and therefore naturally send their sugar there. No sugar from the United States or its possessions can therefore come into competition with Europe in our markets.

The Cobden Club inform their readers that under Article 8 of the Convention "bountied sugar in transit is to be penalized." This is erroneous, there is no such provision in that or any other Article.

They declare that continental producers command our market as much as ever. As a matter of fact this is not true, but if it were it would not be surprising. Cane sugar has not had time to lift up its head, but it is doing so. Bounties made us practically dependent on beetroot sugar for our supplies. That artificial state of things cannot be remedied in a moment. But as a matter of fact we are already importing more cane sugar than we have done for many years past.

The prohibition of bounty-fed sugar from Russia and Argentina is represented by the Cobden Club as having disastrous effects on our market. It has none whatever. Russia exports hardly any sugar to these markets. It supplies the wants of the world in other quarters, and so does Argentina, though in both cases the quantities are a mere drop in the ocean. But it is clear that wherever they go they must displace other sugar which can come to us instead. The world produces as much as it consumes, and we get our share at the world's price.

But these elementary facts are of no use to the Cobden Club. Their sole object is to vilify the Government and mislead the public.

The *Mackay Sugar Journal* has ceased to appear as a separate publication; but it is understood that a "Sugar Column" will appear in each Saturday issue of the Mackay *Mercury*, which will cater for the past subscribers to the *Journal*.

PRICES OF SUGAR IN EUROPEAN COUNTRIES.

The table below was officially compiled by the Board of Trade in response to a question in the House of Commons. It shows the price per pound retail of the kind of sugar most largely consumed by the working classes, whether refined or unrefined, on or about the 1st day of March, 1905, in the capital cities of Germany, Austria-Hungary, Belgium, France, Holland, Russia, Denmark, and Great Britain, respectively, together with the amount, in English currency, of the existing Customs and Excise Duties respectively per pound in each case. The prices given in this return are the prices of the kind of sugar most largely consumed by the working classes in each capital. It is not to be understood that the prices refer to a uniform grade of sugar in the various capitals.

Country and Capital City.	Retail Price per lb.	Customs Duty per lb.	Excise Duty per lb.
	d.	d.	d.
Germany:			
Berlin	$2\frac{3}{4}$	1·02*	0·76
Austria-Hungary:			
Vienna..	$3\frac{3}{4}$	1·98*	1·72
Budapest..	$3\frac{3}{4}$		
Belgium:			
Brussels	$3\frac{1}{2}$	1·11*	0·87
France:			
Paris	$3\frac{1}{2}$	1·44*§	1·18§
Holland:			
Amsterdam‡	$4\frac{3}{4}$	2·45†	2·45
Russia:			
St. Petersburg	$4\frac{1}{2}$	4·22	1·23
Denmark:			
Copenhagen	$2\frac{1}{2}$	0·73	0·27
Great Britain:			
London	$2\frac{3}{4}$	0·45	—

* In the cases of Germany, Austria-Hungary, Belgium, and France, imported sugar is subject to excise duty in addition to import duty proper. The "Customs duty" stated above for these countries includes the total amount of duty payable on importation—*i.e.*, it includes both import and excise duty.

† In the case of Holland, imported sugar is subject to excise duty only.

‡ Amsterdam has been taken instead of the Hague.

§ Including also the "taxe de raffinage," levied equally on imported sugar and on sugar of home production.

THE BRUSSELS SUGAR COMMISSION.

A Parliamentary Paper was issued last month containing all the official correspondence relating to the Brussels Sugar Convention during the first few months of this year, and the deliberations of the Sugar Commission which met at Brussels from April 6th to 11th.

The first few letters deal with the question of Dominican sugar. It was announced last January that the Dominican Congress had reduced the import duties on sugar to 50 cents per 100 lbs. for refined, and 25 cents for unrefined, thus bringing their surtax within the limits laid down by the Brussels Convention. Thereupon the British Government decided to withdraw the Prohibition order against Dominican sugar. This decision was confirmed at the meeting of the Commission in April.

At the sitting of the Brussels Commission in October, 1904, the rates of countervailing duties to be eventually levied on Brazilian sugar were fixed. A month later, a communication was received from the Brazilian Minister for Foreign Affairs, which announced that a Special Commission had been formed in Brazil to make an enquiry into the state of the sugar industry in that country. As the collection of the requisite data would necessitate some delay, the hope was expressed that the Brussels Sugar Commission would await the expiration of another 12 months before deciding as to the treatment to be applied to Brazilian sugar.

In a letter addressed to the Minister of Finance, Rio de Janeiro, the Brazilian Commission wrote :—

Rio de Janeiro,
October 18th, 1904.

Sir,—Immediately after its establishment, the Commission appointed to study the sugar question decided to ask sugar-producing or exporting States for information such as would enable it to ascertain the estimated production for the campaign 1904-1905, and, consequently, to calculate the results which might be produced by the export of Brazilian sugars to the markets of the countries signatory of the Brussels Convention. From the information received, and from that collected from various sources, it appears that the estimated sugar production for the next campaign, 1904-1905, amounts to 2,483,000 bags, which is nearly equivalent to that of the campaign 1903-1904, which was estimated at 2,408,000 bags in the exporting States, namely, Bahia, Sergipe, Alagôas, Pernambuco, Parahyba, and Rio Grande do Norte. As during the year 1903-1904 the foreign export amounted to 11,873,481 kilog., *i.e.*, 6,359,939 kilog., to the United States, and 5,108,103 kilog. to England, it may be assumed with certainty that the amount for export will not exceed that figure during the next campaign.

The Permanent International Commission, instituted by the Sugar Convention of the 5th March, 1902, met at Brussels from the 6th to 11th April.

In accordance with the request of the British Government, the Commission proceeded to a fresh examination of the fiscal system applied to sugar in various countries, respecting which countervailing duties had been fixed in the month of October, 1904.

As regards Bolivia, Guatemala, Honduras, Nicaragua, and the Philippine Islands, the Commission agreed to call for supplementary information on the sugar system in those countries, and to suspend, in the interval, the application of the countervailing duties, the rates of which had been previously fixed.

As for Greece, the Republic of Haiti, Portugal, and the Portuguese possessions, the Commission considered that there was no need to apply the penal clause, basing its decision on fresh information at its disposal; consequently the countervailing duties, fixed in October, 1904, for those countries, have not been maintained.

Argentine Republic.—In view of the new system established by the enforcement from the 1st January, 1905, of the Argentine Law of the 30th January, 1904, the Commission decided to reduce to the figures given below the uniform duty of 50 fr. per 100 kilog. which had been provisionally adopted for sugars of Argentine origin:—

	Per 100 kilog. Fr. c.
Refined sugar, or sugar polarising 96 degrees and more ..	19 90
Unrefined sugar, or sugar polarising less than 96 degrees ..	15 5
Candied sugar..	10 50

As the Customs duties on sugar imported into the Argentine Republic are levied in gold, the value of the gold peso, that is to say 5 francs, was taken as the basis in fixing the above countervailing duties.

Brazil.—Pending a fresh decision, the Commission suspended the application of countervailing duties, which had been fixed on sugar of Brazilian origin, at the session in October, 1904.

Cuba.—The Permanent Commission agreed to adjourn provisionally the examination of the Cuban legislation and any decision as regards sugar from this source.

Dominican Republic.—By a decree of the 5th December, 1904, the import duties levied on sugar imported into the Dominican Republic were reduced to rates below the figures fixed by Article III. of the Convention. Consequently the Permanent Commission decided to suppress the countervailing duties previously fixed with regard to sugar from the Dominican Republic.

United States and Porto Rico.—The Commission pronounced in favour of the adjournment of the decision to be taken respecting the

régime to be applied to sugar from the United States and from Porto Rico.

Mexico.—After an examination of the sugar régime in Mexico the Permanent Commission were able to state that this régime does not call for the application of countervailing duties.

Uruguay and Venezuela.—The Commission decided that there was no need to fix countervailing duties as regards sugar from Uruguay and Venezuela.

The Permanent Commission also examined the request for admission presented by the Swiss Federal Government. The exchange of views on this subject showed that the Commission is not unanimous with regard to the admission of Switzerland on special conditions to the number of the States forming the Sugar Union.

On May 16th, the British Foreign Office received an important despatch from Sir Henry Bergne, in which the latter gave a detailed account of all the discussions which occurred previous to, and during, the April session, and the subsequent decisions of the Commission. This communication contains so much important and valuable information of an official character that we venture to reproduce it in greater part.

Sir H. Bergne to the Marquess of Lansdowne.

In my despatch of the 28th October, 1904, I reported that I proposed to send to the Permanent Bureau, for circulation to the members of the International Sugar Commission, a Memorandum relative to the application of the penal clause to non-contracting countries which maintained a high surtax on sugar. The annexed Memorandum (Inclosure 1) was accordingly prepared by the British Delegates in consultation, and was forwarded to the Permanent Bureau in November, 1904.

[Inclosure 1.

Memorandum by the Delegates of Great Britain concerning the Application of the Penal Clause to Sugars exported by a Country which maintains a high Surtax.

The penal clause, involving as it does the application of penalties by the Contracting States to States which are not parties to the Convention, is liable, unless applied with great caution, and for adequate reasons, to give rise to international complications and to involve breaches of Treaty rights. It follows that the application of a clause like this should be strictly confined to cases in which bounties are proved to exist, or at least to those in which all the conditions necessary to give rise to a bounty are shown to be present. The Commission has, however, hitherto proceeded on a different principle. Without first establishing the existence of a bounty, its procedure has usually been to assess at once the amount of the possible bounty which

might result from a given surtax according to the formula prescribed by Article IV. of the Convention for this purpose. But a surtax does not necessarily give rise to any bounty, and it appears to be the duty of the Commission under Article VII. (*c*), before applying the formula in any particular case, to examine whether, in fact, any bounty exists For how could Great Britain justify to a non-Contracting State the prohibition of the entry of her sugar, which, in fact, has enjoyed no bounty, but which has been treated by the Commission, without examination of all the relevant facts, as though a bounty existed?

It is to be remembered that the limit of six francs was fixed by the Convention for the Contracting States, having regard broadly to the conditions as to the consumption and export prevailing in European sugar-producing countries. In the case of countries whose currency is greatly depreciated, the assumption (often contrary to fact) that duties are levied in gold at par tends to make the application of the formula lead to fictitious results, while the condemnation of countries whose internal consumption is so minute in proportion to export that a surtax cannot possibly lead to an appreciable bounty, or of countries which neither are, nor are likely to become, exporters of sugar, tends to bring the whole procedure of the Commission into disrepute.

Great Britain, from her position as the largest importer, is far more interested than any of the other States in the question of the penal clause, and has to bear the brunt of all the international difficulties to which its application gives rise. It is therefore the duty of the British delegation to press the Commission to confine the fixing of countervailing duties to cases where, after due examination, it has been demonstrated that a bounty exists or is probable.

The Commission should at least go so far as to ascertain whether, in a given case, the price of sugar for internal consumption has been raised by the duty above the world's price, and whether the internal consumption is sufficiently large in proportion to export for this excess of price to give rise to an appreciable bounty on the amount exported. It may, perhaps, be impossible in some cases to go beyond this, and to prove that the bounty which is rendered possible by the above conditions has actually accrued. But the Commission should at least make an effort to obtain information not only as to—

1. Rate of surtax, but also
2. Level of homes prices, and
3. Approximate proportion of home consumption to export.

It is no doubt open to any Contracting State to demand a revision of the rates of countervailing duties fixed in any given case, but the actual rates do not interest Great Britain, which proceeds by means of prohibition.

It seems desirable, therefore, at a suitable opportunity to revise the whole of the decisions already arrived at with regard to certain States, and the Permanent Bureau should at once endeavour to obtain the data referred to above, so far as they are not already available, with regard to the non-Contracting States that have already been considered by the Commission, as well as those which remain for discussion. These views have been repeatedly

urged by the British delegation during this and previous sessions of the Commission.

It is satisfactory that at the thirty-second sitting of the Commission the desirability of the revision suggested above was recognised, and it was agreed that it should be undertaken at the next session. Meanwhile, statistics of internal prices of sugar in different countries will be collected by the Permanent Bureau.

It is also of great importance to obtain all possible information as to consumption, production, and exportation of sugar in each of the countries to be considered: and even where complete statistics cannot be procured, an endeavour should be made to obtain a report of some kind on these points, with a view to throw light on the essential question of the proportion between home consumption and export.

The British delegation wish it to be clearly understood that the above criticisms apply solely to the procedure adopted by the Commission, and in no way to the mode in which the staff of the Permanent Bureau have carried out their instructions.]

It will be observed that stress is laid therein on the duty of the Permanent Bureau to collect information tending to show whether in each case a surtax exceeding the rate fixed by Article III. of the Convention does or does not in fact give rise to advantages of the nature of a bounty. Up to that time the Permanent Bureau had usually only produced evidence of the existence of the surtax, without giving any particulars as to its effect; and the Commission, having to rely solely upon the information which it was the duty of the Bureau to collect, might thus make its decisions without complete examination of the circumstances of each case.

Although I had had occasion previously to urge the view that a high surtax alone was not conclusive evidence of a bounty, the cases actually decided before the session of the Commission in October, 1904, were not of a nature to bring this point prominently forward; and it had not therefore been considered necessary for each individual Contracting State to undertake for itself, independently of the Permanent Bureau, detailed inquiries as to the circumstances in all non-Contracting States as regards price, production, consumption, exportation, &c. It was assumed that this information, where needful, would be collected by the Bureau.

When in the session of last October the Permanent Bureau suggested to the Commission the penalisation of a large number of States on the ground that surtaxes existed in excess of the rates fixed in Article III. of the Convention—but without any particulars as to whether such surtaxes produced bounties or not—no member of the Commission was in a position to offer any independent evidence as to the facts; and in the absence of reliable information tending to show that in any particular case advantages of the nature of a bounty could not really arise from the high surtax, the conclusions of the Bureau could only

be contested in a general manner. However, as reported in my despatch of the 28th October, 1904, I made a formal protest that the Commission was exceeding its powers by condemning countries on the sole ground of a high surtax, without evidence as to whether such surtax produced a bounty.

It was in these circumstances that His Majesty's Government decided to appeal against the decisions arrived at by the Commission last October in regard to the several countries.

The hearing of this appeal having been postponed until the recent session of the Commission, the previous decisions in regard to the above-mentioned countries had remained in the meanwhile in abeyance.

The first subject for discussion at the recent session was, therefore, the appeal of His Majesty's Government, ... and the Commission therefore proceeded at once to consider, seriatim, the cases of those countries in regard to which His Majesty's Government had appealed.

On this occasion the British Delegates were provided with very full and complete information in regard to the circumstances of each case, which had been most carefully collected and prepared by the Foreign Office and Board of Trade. A succinct statement of this information was prepared by the British delegation and circulated to the members of the Commission in advance of the discussion.

It does not seem necessary to recapitulate all the arguments put forward in each case, but the following summary gives the decisions arrived at by the Commission :—

Bolivia.—It was pointed out by the British Delegates that His Majesty's Government had ascertained that Bolivia neither produced nor exported any sugar. Article III. of the Convention states that the limitation of the surtax does not apply to countries which do not produce sugar; there was therefore no occasion to apply the penal clause to Bolivia.

As, however, it appeared in the course of discussion that this information was not in accordance with that previously obtained by the Bureau, which pointed to the probability of some production in Bolivia, it was eventually decided that the previous decision should be suspended pending further inquiry.

Greece.—The British Delegates gave reasons why, having regard to the figures of production, consumption, and importation, it was impossible that a bounty could result from the surtax, and the Commission decided that there was no occasion to fix any countervailing duty in the case of Greece.

Guatemala.—The Permanent Bureau produced some details as to price and exportation, and the British Delegates gave further details tending to show that in this case the surtax could not have given rise

to a bounty—for example, the exports of sugar had been steadily decreasing instead of increasing.

A long discussion ensued, in the course of which I was obliged to insist very firmly on its being the duty of the Commission to record that any decision to apply countervailing duties on account of a high surtax alone applied only to the advantages which might eventually result from such surtax.

It appeared from the discussion that the most various views were held by the different delegations as to the right course to pursue in the case of a country like Guatemala, where the only evidence of a bounty was a high rate of surtax.

Eventually it was decided that the previous decision of the Commission in regard to Guatemala should be suspended pending further inquiry, as in the case of Bolivia.

Hayti.—The Permanent Bureau stated that, since the 19th September, 1904, the importation of raw sugar into Hayti had been prohibited. The importations of refined were now insignificant, and there was no exportation of sugar. The previous decision should therefore be revised.

The British Delegates pointed out that their information showed that no sugar was refined in Hayti, and that therefore the rate of countervailing duty, previously fixed in regard to refined sugar only, had in fact no application.

The Commission consequently decided to cancel its previous decision in regard to Hayti.

Honduras.—The Permanent Bureau had not been able to obtain any new information as to this country, but the British Delegates pointed out that the production was insignificant, and that there was no exportation of sugar.

The Commission therefore decided to suspend its previous decision in order that the Permanent Bureau might seek further information.

Nicaragua.—The Permanent Bureau had been unable to obtain any information. The British Delegates, however, were able to state that all the sugar exported from Nicaragua goes to Central America, and that there was no coalition to influence the price. The production was 120,000 cwt., and the consumption about 90,000 cwt.

The Commission consequently decided to suspend its previous decision in order that the Permanent Bureau might seek further information.

Paraguay.—The Permanent Bureau had received the information that Paraguay exported no sugar, and certain information was given as to prices. Eventually the Commission decided, in this case also, to suspend its previous decision in order that the Permanent Bureau might seek further information.

Philippine Islands.—The Permanent Bureau had been unable to collect any fresh information, but the British Delegates gave figures of consumption and exportation, showing that the proportion of the former to the latter was insignificant. There was no proof of any high price for domestic consumption, or of any combination to raise prices. In these circumstances the existence of a bounty arising from the surtax was impossible.

After some discussion the previous decision of the Commission was suspended in order that the Permanent Bureau might seek further information.

Portugal.—The Permanent Bureau gave some information as to production, exportation, and prices, showing that Portugal did not export any sugar.

The British Delegates, however, based the appeal of His Majesty's Government on the ascertained fact that Portugal neither produced nor exported any sugar, and was thus in any case exempt from the limitation of the surtax under the terms of Article III. of the Convention.

The Commission consequently decided that there was no reason to maintain the countervailing duties fixed at the previous session.

Portuguese Possessions.—The Commission decided that there was no occasion to impose countervailing duties on sugar from the Portuguese Possessions.

It will thus be seen that the appeal of His Majesty's Government has been admitted in every case, either by the suspension or cancellation of the previous decisions of the Commission; and it is to be noted that the present conclusions of the Commission were all arrived at unanimously.

The question of principle, whether Contracting States are or are not bound to penalise sugars from countries where there is a surtax in excess of that fixed by Article III. of the Convention, but where there is no other evidence of a bounty, was not definitely voted on by the Commission.

The Commission, however, may be said to have practically met the views of His Majesty's Government on this point, as regards each of the cases in which the question has arisen, by suspending its previous decisions, when based solely upon the existence of a high surtax, until clear evidence can be obtained as to whether such surtax does or does not in fact give rise to advantages of the nature of a bounty.

(To be continued.)

The Knight Beet Sugar Factory, Alberta, worked up 11,900 tons of beets last year, and obtained 1,580 tons of first-class refined sugar. The capacity of the factory is from 40,000 to 45,000 tons of roots.

SIMPLE METHODS OF CHEMICAL CONTROL.

By T. H. P. Heriot, F.C.S.

I.

What the Factory Manager or Overseer might attempt.

In a former series of articles we reviewed the cane and beet industries from a scientific point of view, and pointed out the urgent necessity of chemical control in cane factories.

Although the cane industry has benefited largely by the results of scientific workers, the fact that scientific knowledge is not yet recognised as the basis of everyday practice may be due to the small scale on which manufacturing operations are generally conducted, necessitating under-paid and inefficient staffs; a state of things which can only be remedied by the gradual amalgamation of estates and the erection of large central factories.

In the meantime, those who continue working on the old lines should be preparing themselves for the future by taking an intelligent interest in what has been held of little practical account by their predecessors. Rule-of-thumb practices must be criticised from a theoretical point of view, and new ideas tested; in short, a scientific habit of mind should be cultivated. Scientific terms and formulæ may be unattractive and frequently obscure, but the general principles are within the reach of all. In the sense that one need not be an engineer in order to admire the ingenuity and commercial value of a machine, so one need not be a chemist in order to judge of his sphere of utility.

It is from this standpoint that we propose to assist the practical man to perform a few simple tests himself, believing that when he is once convinced that science is not "all theory," he will be ready to welcome the trained chemist as a useful co-operator. A few considerations will indicate what constitutes a chemical control, and what difficulties should be avoided in our present enquiry.

The weight of cane may fairly be regarded as the principal factor in controlling operations in the field as well as in the factory. The planter thus learns what yields he obtains from different soils; how these yields are affected by the application of various manures or by different methods of cultivation; and, last but not least, what varieties of seedling canes yield the heaviest crops. The sugar maker, on the other hand, should regard the weight of cane (or, strictly speaking, the sugar represented by that weight) as something to be hereafter accounted for.

But, as is too frequently the case, what is most desirable is often neglected or done indifferently, for unless this duty is entrusted to thoroughly competent and well-paid weighers, the result will only

mislead the practical man who relies on "figures." A degree of accuracy which satisfies the cane farmer does not necessarily pass muster with the chemist, who always has to reckon with the accumulation of small errors.

The accurate weight of cane being the starting point, a complete chemical control should show at a glance the total weight of sugar entering the factory in the form of canes, the percentage recovered as crystallised produce of various grades, the percentage remaining unextracted in the molasses and other by-products, and, finally, the losses occurring at different stages of manufacture. In addition to this routine work, chemical control is required in connection with the distillery, in testing new processes or machinery, and in reducing incidental working expenses by testing the quality of the fuel and stores supplied. After the crop season there is abundant scope for one or more chemists in connection with the analysis of soils, fertilizers, cattle food, &c., and in conducting field experiments of various kinds.

Regarding the manufacture proper, the reader may ask if chemical control ensures a higher recovery of crystallised sugar from a given weight of cane, or whether it merely indicates the admitted imperfections of our present methods of working? To this we reply that without chemical control we should never have ascertained how imperfect our methods are in themselves, nor how imperfectly they are employed. It is not sufficient for the sugar producer to know that his results are as good, or even better than his neighbour's. Are they as good as the means at his disposal will permit? Can these means be improved, and, if so, in what direction? Here the facts to be ascertained are beyond his keenest powers of observation, and "practical experience" completely fails him. Differences which are inappreciable to his unaided senses must be magnified and measured by suitable instruments, and approximate calculations, such as have hitherto sufficed, must give way to accurate statistics.

Absolute accuracy is of course impossible, but that it is an ideal to be aimed at may now be shown. Chemical control is not merely a matter of testing, but also of directing the factory operations by aid of the knowledge gained in the laboratory. But being unable to handle such quantities as are dealt with in the factory, the chemist always makes his tests by means of samples, and all his measurements and weights are of a lilliputian order. Hence, though his laboratory errors may appear insignificant enough, they become painfully evident when magnified to the scale of operations in the factory,—the only scale, be it observed, on which they have any *practical* value.

If errors in testing are unavoidable (and no chemist is infallible), another source of error has to be guarded against. Unless the *sample* truly represents the *bulk*, the chemist's efforts will be misdirected and

his conclusions utterly unreliable. Accuracy in sampling is therefore no less essential than accuracy in testing.

Moreover, chemical analysis only tells us the *percentage composition* of the sample: for example, that the juice contains 13% of sucrose. To apply this result to the actual work of the factory we must know how much juice of this richness has been treated. Hence all chemical control is ultimately based on weights or measurements in the factory.

A complete control, as outlined above, is a laborious undertaking even for a staff of trained chemists; but, bearing in mind that one test, accurately made, gives definite information, we suggest that a *partial* control, if only capable of detecting *avoidable losses*, would be a step in the right direction. Let us illustrate what we mean. The cane mill being admittedly defective as a method of extraction, it is of less consequence to know how much sugar is thus unavoidably lost as it is to know when *unnecessary* loss occurs owing to defective adjustment, irregular feeding, &c. A simple method of gauging the amount of water left in the megass may here serve to indicate the efficiency of the extraction without resorting to more refined analytical methods* required for the estimation of the sucrose.

Every effort should be made to obtain reliable records of the weight of canes ground, for reasons already given, but as that is frequently impracticable without incurring heavy expense, we do not include it as a necessary part of our scheme. Having tested the megass, our second step will be to note the volume, density, and saccharine richness of the juice, in order to ascertain the "indicated sugar" entering the factory *as juice*, from which the highest possible percentage must be extracted in the form of saleable crystals.

Tempering or liming, being a chemical treatment of the juice, is easily controlled by simple chemical tests in the hand of the clarifier "boss"; but the mud discharged from the filter bags or presses will require occasional analysis. The multiple evaporator has fortunately minimised avoidable losses during evaporation of the juice to syrup. Inversion (*i.e.*, the transformation of crystallizable sucrose into uncrystallizable glucose) invariably occurs when neutral or acid saccharine liquids are continuously heated, but with properly tempered juice it is never considerable, and, from our present point of view, may be regarded as quite unavoidable. The subsequent concentration of syrup to masse-cuite is something more than a mere process of evaporation, and is, indeed, the only manufacturing operation demanding highly skilled labour if avoidable losses are to be minimised. The merest tyro can soon learn to boil a pan and produce crystals *of a sort*, but it takes the best part of a lifetime to learn to work a pan with the highest possible efficiency. The pan-boiler is responsible for loss of sugar due to over-heating (inversion), insufficient concentration

***The reader should refer to an interesting resumé of these methods by MM. Pellet, a translation of which appears on p. 331 of this Journal.**

before striking out, and loss of first product which occurs when the grain is too small, irregular in size, or mixed with false grain. Here, if anywhere, chemical control may be employed with the greatest practical advantage. If each strike of masse-cuite could be separately weighed and cured, we should speedily detect careless work, and take the necessary steps to prevent its repetition. Unfortunately this desirable precaution is very rarely practicable, and the improved methods of handling masse-cuite now coming into use only add to the difficulty of weighing, or accurately measuring, large quantities of this material. For the partial control now under consideration it will be more satisfactory to determine the yield of sugar from each strike of masse-cuite on an experimental scale. The proper working of the centrifugals will be controlled by "polarizing" the cured sugar, and suitable tests will show when the maximum quantity has been recovered by reboiling the molasses.

Finally, it must be noted that the small factory can rarely dispense with artificial fuel, whether in the form of coal, wood, bamboo, or represented by the wages paid for sun-drying the megass. Our partial control will therefore conclude with some observations regarding the quality of the fuel and the working efficiency of the steam plant.

Such; in brief, is the scope of the enquiry to be developed in subsequent chapters. The present one may conveniently conclude with a few directions and notes on weights and measurements in the factory.

1. *Weight of Canes.*—Accurate weighings being rarely possible, except where transport is by rail and with a scale capable of weighing several trucks simultaneously, these conditions will have to be assumed in what follows. The precautions to be observed being, however, of general applicability, may serve as a guide to the manager of a small factory, where canes have to be weighed in single cartloads.

The types of weighing machines requiring no special description, we will proceed at once to consider how errors may be detected.

(*a*) *Clerical errors* are the most frequent, and may include errors in reading off the weight from the machine in addition to those of recording the same. These may be eliminated by using the Patent Recording Steelyard made by Messrs. Avery.

(*b*) *Errors in the tare.*—The trucks should be weighed singly before the commencement of the crop season, after being put in thorough repair. The weights may be painted on the sides of each truck, but it is better to merely number the trucks and to record the corresponding tares on a card fixed over the cane-weigher's desk; the number of each truck forming one load should be recorded opposite the gross weight, so that the net weight of cane may be subsequently checked.

(*c*) *Errors of the scale.*—These are comparatively rare, but may be caused by over-loading or by sudden strains. If the scale be erected

with a view to obtaining free access to the reducing levers (supporting the platform) any defect in their action may be detected by an occasional examination whilst in use. A scale should be tested to its full loading capacity at least once a year, and this is most conveniently carried out by weighing a train of trucks, each of which is loaded with as many bags of sugar as will approximately represent the weight of a load of cane. The true balance of the empty scale being first secured by careful adjustment, the tare of each empty truck is noted. The sugar must be bagged off on a tested sugar scale with every precaution to ensure accuracy, and a known number of bags loaded into each truck and the latter weighed together. If the indicated weight does not agree with the known weight (of the bagged sugar plus the tare weights of the trucks), the difference is the error of the scale when fully loaded. By detaching one truck at a time and weighing the remainder there will be obtained a series of observed errors (probably diminishing as the load on the scale is reduced) which must be individually recorded. The correction to be applied to subsequent weighings of cane will consequently depend on the number of trucks forming each weighed load.

(*d*) *Errors due to fraud* are not uncommon where canes are purchased from the farmer. The possibility of bribing a native cane-weigher to falsify his weights should never be lost sight of; there are also many ingenious methods of making a load weigh more than it should. Except where farmers' canes are weighed in carts at a loading station, and then loaded into trucks which are weighed at the factory yard, the results will always remain open to criticism. The quantity of trash, roots, &c., which accidently find its way to the scale must be approximately known when a chemical control is to be based on the weight and saccharine richness of the canes ground, and it is generally sufficient to supervise the unloading of one truck every day so that the débris may be collected and weighed.

(*e*) *Errors due to evaporation* of water from the cane occasionally occur when some mishap in the factory stops the mill, leaving a quantity of weighed cane in the yard. If such a stoppage can be foreseen, a few trucks may be weighed separately, and re-weighed as soon as milling operations recommence; the loss in weight being then calculated on the total weight of canes in the yard. But in other cases it is very difficult to apply a proper correction, as the loss by evaporation mainly depends on temporary atmospheric conditions.

2. *Measurement of the Juice.*—The direct weighing of juice being at present an unsolved problem, the alternative method of measurement is the one usually adopted. But the juice, as it flows from the mill-bed, is covered by a thick layer of foam, so that accurate measurement of the true volume is very difficult. When heated nearly to its boiling point, all air is driven off and the liquor presents a clean surface, but as its true volume is now exaggerated owing to

expansion by heat, a correction must be applied in order to arrive at the truth. Again, in order to measure a continuous output of juice, more than one measuring vessel must be available. These conditions are fairly well satisfied by the juice-heater and liming tanks to be found in nearly every small factory. To convert a battery of liming tanks into measuring vessels, provision must first be made for always filling the tanks to a certain level, say a few inches from the open top. A good way of doing this is to rivet a short arm or bracket to the top of each tank, so that the arm projects horizontally over the liquor. The free end of the arm may then either be bent vertically (downwards), and the bent portion tapered to a point, or, preferably, an inverted cone is attached to the extremity of the arm or bracket. In either case, the point indicates the exact height to which the liquor ought to be allowed to rise, the juice-cock being closed as soon as the surface of the juice actually touches the point. If too much juice has been added, this is easily detected by the point being slightly immersed. Such indicators are easily made at the forge, and should be securely fixed to the tanks in a position clearly visible to the workmen in charge. The next step is to carefully measure the internal dimensions of the tanks as regards length and breadth, the required depth being the distance between the point and the bottom of the tank. (Note.—It is very convenient, though not essential, that each tank should hold a round number of gallons, or other measures, and that the exact level to which they are filled should allow for expansion by heating, and thus eliminate corrections.) The necessary calculations will be indicated in a subsequent chapter.

All such measurements presuppose that the sides of the tanks are not bulged or otherwise out of shape. In such cases, or where the capacity cannot be easily calculated from the dimensions, it must be directly ascertained by filling the tank with water to the required level, and running the water into a vessel of known capacity, which, if smaller, is repeatedly filled until the entire volume has been measured in instalments.

The small quantity of milk of lime, added to each clarifier, will not cause any appreciable error, but it is important that the mixing of the tempered juice should cease some time before the tank is fully charged in order to avoid agitating the surface of the juice when the required level is reached.

In the foregoing method, the accuracy of the measurements depends entirely on the men in charge of the work, but as errors in opposite directions tend to neutralize each other, the average results will be sufficiently exact for our present purpose. For a complete chemical control, the adjustment of the level should be effected automatically by means of an overflow from each tank into the next, or into a gutter from which the surplus juice gravitates back to the juice pump. The

men in charge have then merely to fill the tanks until juice commences to overflow.

3. *Weight of Sugar cured.*—This everyday practice calls for few remarks. The scale should be kept scrupulously clean, carefully handled, and moved as little as possible. The empty scale should be balanced daily before bagging off commences, and a loaded test made once a week by means of standard weights. One-tenth the weight of ten bags serves as an accurate tare to be added to the net weight of sugar per bag. If the bags be filled whilst on the scale, and never lifted on to it after being partially filled, the usual life of the scale may be doubled. By attention to such details the customary surplus or "over-weight" may be considerably reduced without risking complaints.

4. *Weight of Fuel.*—A coal-scale is a sound investment for every small factory burning such fuel, and, if used intelligently, it will show how much coal is required per day by each furnace, and how much finds its way outside the factory. The precautions to be observed in weighing have been already sufficiently indicated.

(To be continued.)

THE NAUDET PROCESS.

By Robert Harvey, M.I.Mech.E.

(Of Harvey Engineering Company, Limited, Glasgow.)

The important and interesting process, commonly known as the "Naudet," has been at work in the West Indies from about the beginning of the present year in the islands of Trinidad and Porto Rico.

The Principles of the Process.

This process consists of treating the megass from the ordinary three-roller mill, only it is necessary to have a crusher in front of the rollers or a shredder immediately behind them, so as to have the cells of the cane laid thoroughly open and thus give a good exposure to the hot juice which it comes in contact with when in the vessel of the diffusion battery.

The term "diffusion," as applied to this process, is not strictly correct. By diffusion we understand the action which goes on when two given liquids are separated by a membrane, the salt or sugar on the one side passing through to the liquid lying on the other side of the membrane; this action continues until equilibrium is established—that is, till the two liquids possess the same amount of salt or sucrose. This is what occurs in the extraction of sugar from beetroot. In that case it is necessary to see that the roots are sliced

up to a sufficiently fine degree so as to bring the membranes of all the cells into contact with the liquid. But with the sugar cane the case is different. Under the action of the mill rollers and shredders all the cells are bruised or opened up, and the sugar which remains in the megass is retained there simply because it is of a spongey nature. This is shown by the fact that under the action of the rollers the juice exudes from the pressed canes, and when the bed of megass is very thick one can with the hand squeeze out juice from this mass.

To reduce the thickness of the feed, or rather the discharge from the mills, double crushing was introduced—a great improvement on single crushing; a still further improvement is triple crushing, and on some estates in Java there is quadruple crushing. All this is to overcome what is well-known as reabsorption in the megass; but no amount of crushing—it does not matter how many times—can ever extract all the juice from the cane because of this absorption—an essential evil in all mills.

Another evil in this repeated crushing of the megass is the fact, well known to all sugar makers, that with every additional crush after the first mill, impurities are imparted to the juice from the rind of the cane, and in proportion to the number of times the megass is re-crushed the impurities are increased, so that the resulting juice is more difficult to work; furthermore, all these impurities have to be eliminated before good sugar can be made.

Now, the "Naudet" system overcomes these evils, and that in one operation; the juice coming from the first mill, where the crushing should only be from 60% to 65% of the juice in the cane, is comparatively pure. The remainder of the juice, which is still held in the megass, is then extracted without any pressure of rollers, but by the contact of the highly-heated juice on the megass. The final washing or lixiviation is accomplished by a small proportion of water, which practically exhausts the megass of all sweets or sucrose.

Caroni.

The first start was made on the "Caroni" Sugar Estate, Trinidad, in the month of February. The machinery on "Caroni" Estate, previous to the new process, was double crushing. The first mill was the weakest one, the rollers being 36 in. dia. × 78 in. long. The carrier was supplied from a steam railway going right alongside the same.

Crushing by the first mill gave an extraction of about 65%. This juice, known as the normal juice, was pumped up to a tank sufficiently high to supply the diffusers by gravitation.

The megass from the first mill is elevated by one carrier to another, sufficiently high above the top of the diffusers to supply the same by gravitation. This elevated longitudinal carrier, which is pretty near

the top of the building, has shoots arranged with doors to supply any of the cells of the diffusion battery. The latter consists of ten cells in two parallel lines of five on each side, each cell having a capacity of about 50 hectolitres. When a cell is filled with megass from the first mill, a certain proportion of cold normal juice flows by gravity into this diffuser, and then on the top of this, to completely fill the cell, a proportion of hot limed juice from the meichage or liming tank is admitted. The diffuser is then closed.

Connexion is then made to the circulating pump, and the cold juice is then drawn from the bottom of the diffuser through strainers and delivered by a pump through special designed juice heaters to the liming tank and at the same time to the top of the diffuser. This circulation is repeated till the juice under treatment is raised to between 218° and 220°F. In this way the juice is completely sterilised, and the duration of the operation is under ten minutes from the time the juice is expressed from the cane. Seeing the juice is thus almost immediately sterilized as it is expressed from the cane and never exposed to the air, but enclosed completely during the whole operation until it reaches the triple effet, the loss and risk from inversion is very small. This hot juice is then discharged into the diffuser, the top door closed, and the circulation by pump at once effected. The crushed megass in the diffuser during this operation acts as an excellent filtering medium; in fact, one of the best that has yet been discovered for sugar cane juice, as was shown by the clear and limpid condition in which the diffused juice was discharged from the battery.

After the megass in the cell has been completely exhausted of all its sweet (by a washing with a small quantity of water), compressed air is admitted to the top of the cell so as to force this water through the megass into the adjoining cell, any sweet that is contained in this water being thus utilised in the succeeding operations. The bottom door of the cell (about 6 ft. diameter) is then opened, and the exhausted megass falls on to a carrier running underneath the centre of battery, which receives the exhausted megass of each cell as the same is discharged. This carrier conveys the exhausted megass to another elevating carrier which supplies the feed to the second mill.

The second mill is a strong mill of modern design, having rollers 36 ins. × 78 ins. with extra strong gearing and powerful engine. By this mill the waste water in the megass is well extracted, and only about 48 per cent. of water being left, it burns freely and forms an excellent fuel for the boilers.

The juice from the diffusion battery is forced by a pump into a tank with central division, on the same level or platform as the normal juice tank. This allows one half of the tank to be filled

while the other half is discharging if necessary. This tank gives the measure of juice coming from the battery and is called the triple effet supply tank. Another tank (the meichage or saturation tank) already mentioned, placed on the same level as the normal juice tank, receives a certain proportion of the juice from the diffusion battery which is to be used in the succeeding vessel for the saturation of the megass, along with a certain proportion of juice from the normal juice tank.

The discharge tank from battery is sufficiently high to supply the triple effet, and as the factory was making dark crystals for the American market the juice from this diffusion battery tank went direct into the triple effet, thus doing away with all defecators, subsiders and filter presses, and so reducing the sugar making to the very simple and direct operation.

The operation from the triple effet to the vacuum pan and centrifugals remained as it was in the previous year.

The actual results obtained on "Caroni" fell short of what was expected owing to the megass from the first mill not being in a suitable condition for the diffusion, this three-roller mill not having a crusher to split open the cane before entering the mill nor a shredder to shred the megass as it left the mill: the extraction of juice was not complete and the dilution was too high, so that a little extra fuel was required beyond the megass for the boiler. The next year this defect will be overcome, when no doubt the factory will work through the crop without any fuel beyond the exhausted megass. As it was, however, the results of the crop were much in advance of the double crushing of the previous year—a larger quantity of sugar being produced from the same weight of canes; furthermore, at the end of the crop, the estate produced fine yellow crystals for the London market. The proprietors of the estate are satisfied that the principle of the process is correct and that, when the necessary alteration is made on the first mill, next year's operations of the Naudet process will be in every way satisfactory and will prove in every sense a commercial success.

Fortuna.

At the estate "Fortuna," near Ponce in Porto Rico, the diffusion battery is of the same dimensions as the one just described, but the arrangement is different—that is, while there are ten cells of about 50 hectolitres capacity, as in Trinidad, these ten cells are arranged in one line, the intention being in another year or so to add another line of ten cells, so that the capacity of the estate would be doubled. On this estate the cane-crushing mill had rollers 32 ins. dia. × 66 ins. long, but in front of these was a Marshall crusher with large and powerful rollers, which prepared the cane for the crushing in the

three-roller mill; the cells of the cane being thus thoroughly opened up allowed the hot juice to act rapidly on the megass, giving thereby immediately a very high extraction, so much so that the juice from the battery was only 0·7 degree Bé. less in density than the juice from the mill, the dilution being about 9% of water, and for every 100 gallons of juice contained in the cane about 93 to 94% of same was extracted, the megass being in a much better condition for diffusion than at "Caroni."

On this estate, by sulphuring the juice in addition to the liming, and passing the juice through Philippe filters from the battery, a very fair white sugar was produced, suitable for local consumption. Given a certain purity of raw juice in good working, an equal purity in diffusion juice and syrups results. At Fortuna the purity of raw juice was during the third week 84·2; purity of the diffusion juice 84·1.

When everything was going on well at "Fortuna" we had an extraction of 96 to 97%. This year on Messrs. Hinton & Son's sugar estate in Madeira the average extraction throughout the whole crop was 95·5%; and 40% of the canes ground were Yuba or Natal canes, a very small, hard variety.

The recovery of sugar at "Fortuna" was good, being as under:—

		Per cent.
Sugar in cane		13·5
Recovered—First sugar	10·0	
,, Second sugar	0·5	
Sugar in molasses	1·8	
		12·3
Total loss		1·2

The fuel question, however, was not satisfactory owing to the machinery in the factory not being able to overtake the amount of juice produced by the battery—that is, the triple effet, vacuum pan, and centrifugals were much under the power required. The boiler installation and the furnaces were also defective, so that here again extra fuel was required beyond the megass; otherwise the process was similar to what I have described as carried on at "Caroni."

(To be continued.)

ON THE ESTIMATION OF SUGAR AND FIBRE IN CANE AND MEGASS.*

By H. and L. PELLET.

Whereas the determination of crystallisable sugar in beets is a simple matter when the fresh chips are analysed by our method, observing all the precautions we have previously indicated, it is quite otherwise in the case of the sugar cane.

In a paper which appeared in the *Annales de la Science agronomique française et étrangère* we pointed out the difficulties met with in ascertaining the true saccharine richness of the cane. These difficulties are always present, at any rate in those factories which employ mills to extract the juice, with or without maceration of the megass. In usines, where direct diffusion of fresh chips is the method of extraction, the determination of the real saccharine richness of the cane presents less difficulties, and the operations are almost the same as for the beet. Samples of the fresh chips are taken as each diffuser is charged, and these are mixed every hour (during which time a "round" of the batteries is generally completed) and a preliminary test made to find the density of the juice. A known weight (or volume) of this sample (corresponding to the number of diffusers worked per hour), is preserved in a closed metal can, within which is placed an open flask containing concentrated ammonia, the fumes from the latter ensuring the preservation of the cane chips for at least twelve hours.

At each change of spell, a direct analysis is made of the chips thus collected. The chips are mixed, and a sub-sample crushed up in an iron or bronze mortar. From this finely divided mass, 100 (or 81·5) gr. are weighed out and the sugar extracted by means of Zamaron's apparatus.

We have found that a certain number of extractions are necessary, boiling each time for about ten minutes. Each should consist of from 150 to 160 cc. of water, so that six extractions yield about one litre of extract.

When the canes are very fibrous, as is the case in Egypt, we find it better to treat the material more than six times and to collect as much as 1500 cc. of extract in certain special cases. As a further precaution, we recommend that the extracted residue be finally boiled with 300 cc. of water and the resulting extract polarised. This always contained a small quantity of sugar representing from 0·05 to 0·15 gr. of sugar per 100 gr. of cane.

On the other hand, we have determined the richness of the cane indirectly by extracting the whole of the juice from the chips by means of a powerful laboratory mill driven mechanically. About

* Translated from the *Bulletin de l'Association des Chimistes.*

two litres of chips were taken in each instance and the juice extracted by the first pressure measured. The mill was then tightened, and the juice obtained by a second crushing, collected and measured. Finally, a litre of water was added to the residue, the whole mixed, and crushed a third time.

Each of these three juices being measured separately, a proportional volume of each was mixed so as to form the mean sample for analysis.

The object of this analysis was to ascertain the composition of a juice which closely resembles that obtained by diffusion (or by triple-crushing with maceration), as regards purity and the reducing sugars (glucose ratio). We then calculate the composition of this juice when the density is equal to that of the first mill juice, or "normal juice."

Some years ago we determined what coefficient should be adopted to calculate the richness of the cane from the richness of the juice, and found this to be 0·87 when the fibre was about 10 %. It is evident that we can also calculate the richness of the cane from that of the first mill juice by means of a coefficient which will give concordant results with that of the direct analytical method.

In the direct analysis of cane chips we have, at any rate, some certainty that the samples represent the mean quality of the cane. One day there may be an error in one direction which will be neutralized on another day by an error in the opposite direction, so that in the course of a week or ten days the average result is sufficiently near the truth for work of this kind.

Here is an example taken from last year's records:—

Per cent. sugar in the cane (by direct analysis)	13·06
,, ,, ,, (obtained by the coefficient 0·87)	13·00

By adopting the coefficient *100—Fibre*, we found:—

Per cent. sugar in the cane	13·36

But when the cane is not treated by diffusion, the determination of its richness is extremely difficult. This arises from the variations in richness of the various parts of the cane-stem, or of one cane as compared with another; and the practical impossibility of taking a mean sample which shall represent the average composition of the canes passed through the mill. In the case of whole canes, it is therefore absolutely impossible to obtain such a sample, were it only for a quarter of an hour's work; for the canes sent to the mill differ as regards quality, size, and state of maturity. Even to obtain an approximate sample it would be necessary to collect a considerable number of canes if the results are to approach the truth. Moreover, the analysis of the canes only, neglecting the tops and various débris, almost always indicates a higher saccharine richness than that which ought to be found.

But even adopting the best known methods for reducing the whole canes to a finely divided state, and operating on 20, 50, or 100 gr. or

more, the direct analysis of the whole canes yields results which entirely disagree with those calculated by means of coefficients and which are approximately true. Consequently the richness of the canes cannot be determined by direct analysis of the whole canes in factories which have only crushing mills. What, then, is the coefficient to use in calculating the richness of the cane from that of the juice?

According to our experience with Egyptian canes, we have adopted a mean coefficient of 0·87, which is based on the richness of the juice extracted by three crushings. A coefficient can also be applied to the first mill juice, but this ought to be verified, for it will not be the same for all the factories of even one country, where the sugar content of the canes ground may vary from 10·3 to 14·3%; nor, again, for every year, as the cane may contain 12% of sugar one year and 15% of sugar the next. Moreover, as the canes do not ripen at the same period from year to year we think it advisable to verify the coefficient to be applied from time to time.

H. C. Prinsen Geerligs gives the following table of coefficients adopted in Java:—

Table used in Java for calculating the Richness of the Cane from that of the Juice.

Extraction in kg. per 100 kg. of cane.	9·5	10·0	10·5	11·0	11·5	12·0	12·5
65	84·60	84·40	84·20	84·00	83·85	83·75	83·65
66	84·75	84·60	84·45	84·30	84·15	84·05	83·95
67	85·05	84·90	84·75	84·60	84·45	84·35	83·65
68	85·40	85·20	85·05	84·90	84·75	84·60	84·45
69	85·70	85·50	85·35	85·20	85·05	84·90	84·75
70	85·95	85·70	85·60	85·50	85·35	85·20	85·05
71	86·15	86·00	85·90	85·80	85·65	85·50	85·35
72	86·45	86·30	86·20	86·20	85·95	85·80	85·65
73	86·70	86·55	86·30	86·40	86·25	86·10	85·95

But few canes yield 65% of juice with single-crushing. Sometimes this amount is not obtained with dry double-crushing, nor even with double-crushing and maceration. Having ourselves carried out several tests with all possible care, and under the best conditions for obtaining the maximum of extraction, we did not succeed in exceeding 70% of juice with double-crushing and maceration. This, in our opinion, goes to show the "resisting" nature of the fibre in the canes ground.

In Mauritius the coefficient 0·84 is employed. In Cuba, according to Colson, the coefficient is based on *100 — Fibre*, and varies from

0·89 to 0·88. The extraction varies from 66·6 to 74·8 per cent. of the canes (dry double-crushing). In Réunion, according to the same writer, we find a coefficient of 0·878 with 10% of fibre.

In the Hawaiian Islands they also adopt the coefficient based on *100 — Fibre*, the following figures being given for the Ewa Usine in 1899:—

Fibre per 100 of canes	11·37
Total juice in the cane	88·63
Sugar per 100 grammes of juice	16·67

and $16·67 \times 0·8863 = 14·76$—the richness of the local canes.

The coefficient 0·83 has also been given for calculating the richness of the cane from the percentage by weight of sugar in the juice. We see, however, that one of them is not in accord.

Now there is one point about which there is no question, viz., that the juice of the first mill, whatever be its quantity, does not represent the mean quality of the total juice of the cane, since the juice first expressed is always purer and richer than that expressed by the second and third mills. The differences vary according to the conditions.

Moreover, the fibre does not exist in the cane in a state of dryness, but in combination with water free from sugar, as we have pointed out in our experiments with beet and cane in connection with Scheibler's research. Hence a coefficient based on the formula *100 — Fibre* is quite inadmissible for calculating the richness of the cane from that of the first-mill juice (erroneously termed the normal juice).

This being so, what coefficient should we adopt? We believe it is impossible to find one that can be applied to the canes of all countries, containing, as they do, from 9 to 18 per cent. of sugar, and to canes worked up during 3, 6, or 9 months (as in Cuba). Moreover, the power of the factory mills does not correspond with that employed in the laboratory; the cane fibre being also more or less "resistant," according to the particular species cultivated, the rate of maturation, and also whether irrigation is necessary to supplement the insufficient rainfall.

But it is not difficult to determine this coefficient, and to verify it every week or ten days, by examining the juice extracted by the first mill from a given weight of cane. The volume of the juice can also be ascertained with sufficient accuracy, and even very accurately when certain precautions are observed. It is further necessary to estimate the sugar in the juice from the second and third mills, as well as that left in the megass, in order to arrive at the total sugar in the canes ground. We deduce therefrom the relation between the juice of the first mill and that of the cane.

The sampling of the megass demands great care, as the analytical results obtained serve for calculating the loss in sugar (from the weight of the megass and its sugar-content).

The volume of the juice is not always easy to obtain. It frequently happens, especially with second or third mill juices which are very frothy, that an error corresponding to 1 or 2 per cent. of the total volume is made, introducing an error of from 0·15 to 0·30 sugar per 100 gr. of canes. Yet, on the whole, we arrive at a result much nearer to the truth than would be attained by any other direct method. Nevertheless this calculated richness is not altogether reliable, for although it may be true of the canes actually tested, it does not apply to the actual canes entering the factory.

In countries where a large number of hands are employed in the manipulation of the canes, it is practically impossible to prevent a certain quantity being eaten or stolen. Then there are also damaged canes, others which have partially dried, and those with fragments of leaves, débris, or soil adhering to them; all of which tend to increase the total losses in the factory. Thus, in addition to the true saccharine richness of the cane, there is an "industrial" richness, which comprises the total sugar extracted plus all the losses in extraction referred to the weight of cane. This "industrial" richness may be inferior to the true one, as an error of 1 to 2% is frequently found, corresponding to at least 0·15 to 0·30% of sugar. Obviously it is necessary to be certain of the volume and accurate sampling of the juice. When air bubbles occur in the juice, its volume is exaggerated and too high an extraction is indicated.

On the other hand, if too low a coefficient be adopted, the true richness of the cane is under-estimated and the calculated extraction of sugar per 100 parts of sugar in the cane is in excess of the truth. Similarly if too high a coefficient be adopted the calculated loss of sugar in the juice is increased; but this may perhaps be compensated by inaccurate measurement of the volume of juice owing to secluded air bubbles.

In the first case, the extraction of the mill appears better than in second, but the unknown losses are much greater in the first case, since the saccharine richness of the canes has been over-estimated.

It is clear, therefore, that the best method to adopt is to ascertain the actual weight of the juice extracted, and with this object the Planters' Association of Java has offered a prize for a weighing apparatus which will be equally applicable to first, second, and third mill juices separately or mixed.

There yet remains the question of the exact determination of the loss of sugar in the megass by weighing the latter and estimating the sugar content in order to find the loss in sugar per 100 parts of canes ground.

The estimation of sugar in the megass is by no means a simple operation, as we have ourselves discovered. The canes being of very variable richness, the megass is subject to the same variations. When maceration water is added at the mill, the pores of the megass

are more or less saturated, so that the final megass is far from uniform in composition. We are therefore obliged to take a very large sample in order to secure a reliable average. As the megass is never sufficiently finely divided for analysis, it has to be cut up and an average sample secured for the estimation of the water, sugar, and fibre.

At least 50 gr. should be taken for the estimation of the water in duplicate tests, the samples being dried on special baskets, and the weighing being made as rapidly as possible.

For the estimation of the sugar, 50 (or 81·5) grs. of the material are extracted by successive washings in Zamaron's apparatus, following the instructions already given in the analysis of canes. This estimation should also be made in duplicate.

The percentage of fibre is ascertained by drying the residue resulting from the estimation of the sugar. Having estimated the percentage of fibre in the cane by the same process, the ratio of megass to cane can be calculated, and consequently the loss of sugar in megass per 100 parts of cane.

The percentages of fibre as found by direct weighing may be verified by calculation, assuming that the sugar content of the megass represents juice of the same purity as that of the last mill juice, which is only approximately true. The two results differ very little when the analyses are carefully executed in duplicate.

As a further proof that the direct estimation of the sugar in the megass is a problem of some difficulty, we need only cite the variety of opinions as regards the quantity of material to be treated and the method of extraction. Some prefer to estimate the sugar in 20 gr., 50 gr., or better still 100 gr. of a finely-divided average sample. Others consider it necessary to treat 500 or 1000 gr. in order to obtain reliable results.

Some recommend cold water for washing the megass, or boil it once in contact with the megass; whilst the experience of others is that none of these methods are capable of giving accurate results in all cases.

In view of our own numerous experiments we can confidently state that if the necessary precautions are taken in preparing an average sample, the analysis of the megass can be made on either 20 to 50 gr. as a minimum, but preferably on 100 gr. duplicating tests, and collecting in all 1500 cc. of extract. The residue is finally treated with 300 cc. of water, and this extract polarised separately in a 400 mm. tube in order to make sure that the extraction is complete to within 0·05%. We may add that the extraction by means of cold water is not capable of general adoption; if it gives reliable results in treating very finely divided and well-crushed samples, the results are inaccurate and much too low when applied to megass obtained from unripe canes, or those of a "resistant" nature and which are

not thoroughly broken up by the double or triple-crushing, as can be proved in the case of Hawaii and Java. In any case, it is absolutely necessary to adopt the process of successive extractions as a basis of comparison with simpler or more rapid methods.

On the Direct Estimation of Sugar in Cane and Megass by Digestion with Alcohol and with Hot Water.

We propose to describe comparative tests made by these two methods.

In the first, the canes were cut up into slices and then crushed in an iron mortar until a sufficiently uniform and finely divided material was obtained. 100 gr. were submitted to seven successive extractions with boiling water in a Zamaron apparatus, of ten minutes' duration each, and the resulting extracts analysed separately.

The same was done with alcohol of 95°.

The results obtained were as follows:—

	By Hot Water.		By Alcohol.
1. Sugar extracted (% cane) ..	7·160	....	7·047
2. ,, ,, ..	2·530	....	2·825
3. ,, ,, ..	1·416	....	1·219
4. ,, ,, ..	0·594	....	0·505
5. ,, ,, ..	0·211	....	0·258
6. ,, ,, ..	0·085	....	0·116
7. ,, ,, ..	0·056	....	0·045
	12·052	....	12·015
Sugar remaining in the megass.	0·022	....	0·014
Total sugar (% cane).. ..	12·074	....	12·029

We have also compared the former with other methods of estimating sugar in the same sample of cane, with the following results:—

1. (*a*) By numerous successive extractions with boiling water	14·70
(*b*) Do. do.	14·84
2. (*a*) By a more limited number of successive extractions with boiling water	14·18
(*b*) Do. do.	13·52
3. By a single extraction with hot water, continued for $1\frac{1}{2}$ hours	12·87

Obviously these errors are not constant, and might be less if the canes were soft and perfectly ripe. They will also vary according to the season, the year, the variety of cane treated, and the state of division of the sample.

The foregoing results were obtained with Egyptian canes such as we have had occasion to examine for many years.

Estimation of Sugar in Megass.

In Egyptian factories the double crushed megass is analysed by the same methods as are used for the sliced cane, *i.e.*, the sugar is extracted by successive washings, employing either hot or cold water.

The finely divided megass, treated by the several methods, gave the following results.

Without maceration at the mills :—

(*a*) Successive extraction in Zamaron's apparatus ..	10·65
(*b*) ,, ,, ,, ,, ..	10·46

By a single extraction with hot water for 15 minutes, the vessel and contents being weighed before and after heating—

(*a*)	9·00	(*b*)	9·76

By a single extraction with cold water of ¾ to 1 hour's duration—

(*a*)	3·52	(*b*)	4·05

A second series of tests gave the following results :—

Per cent. sugar in megass: by successive extraction in Zamaron's apparatus..	9·66
By a single extraction with hot water	9·44
,, ,, cold ,, ...	5·27

Extraction by means of cold water is therefore absolutely unreliable in the case of megass of a "resistant" nature, and should only be employed when the megass is "spongey" and when the results can be checked by the method of successive extractions with hot water in Zamaron's apparatus. The latter, as now perfected, has proved invaluable in cane factories for analysing canes, fresh chips, and more or less "exhausted" megass. The baskets of perforated metal, being of uniform weight, the weight of the material before and after treatment with water can be quickly ascertained.

We quote one of many examples to prove that in a single treatment with water the extraction is not complete even in one hour. Megass which had been finely shredded, and then cut up into small pieces, was digested with ten times its weight of hot water.

	Per cent. Sugar.
After 15 minutes heating..	6·10
,, 30 ,, ,, ...	6·50
,, 60 ,, ,, ...	6·70
By successive extractions	7·10

(To be continued.)

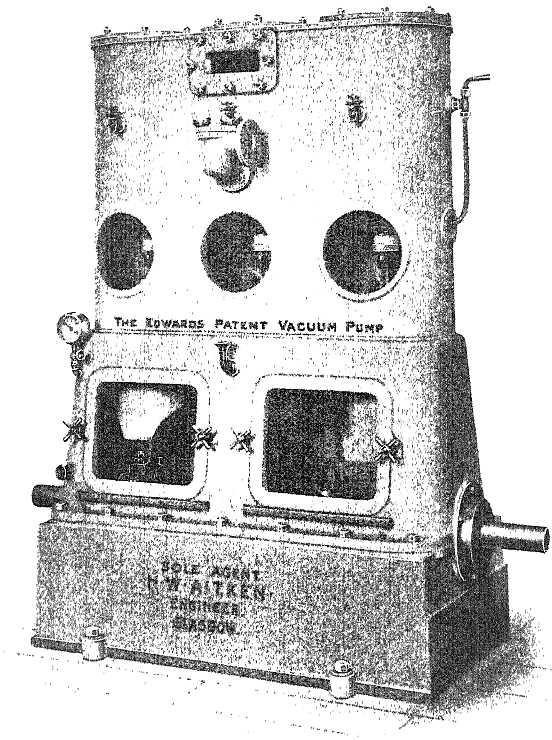

THE EDWARDS PATENT VACUUM PUMP
SOLE AGENT
H·W·AITKEN·
ENGINEER.
GLASGOW.

Fig. 1.

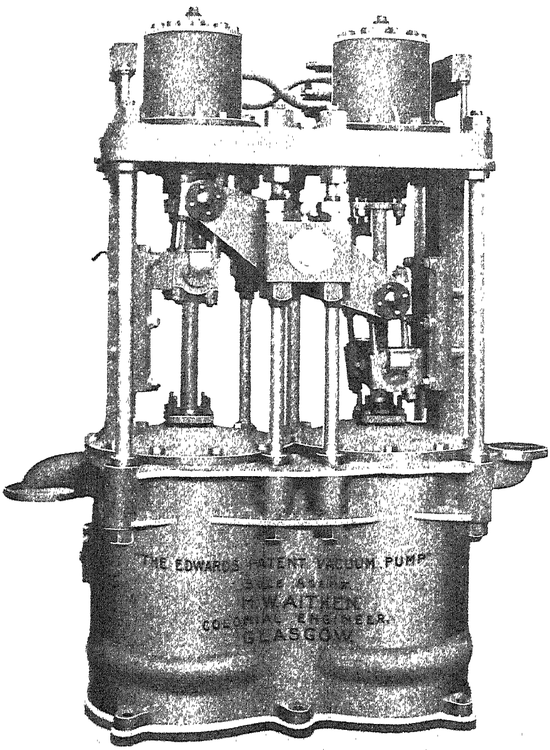


Fig. 2.

THE EDWARDS PATENT VACUUM PUMP.

During the three years that have elapsed since we drew our readers' attention to the special features of the Edwards Patent Vacuum Pump for working in connection with apparatus used for evaporating and concentrating sugar solutions *in vacuo*, we learn much progress has been made in their introduction into this particular industry. Edwards Pumps are now working in almost all cane sugar countries, including Cuba, Demerara, Trinidad, Porto Rico, Brazil, Argentine Republic, Australia, Hawaiian Islands, &c., and have in all cases given the satisfactory results that have been claimed for them. The Pumps are working in connection with "Jet" and "Torricellian" Condensers, as "Auxiliary" Pumps dealing with the air and incondensible gases while the ordinary Pump deals with the water, and as Calandria Pumps.

Mr. H. W. Aitken, of 147, Bath Street, Glasgow, who is the sole agent of the Edwards Air Pump Syndicate for Pumps used in sugar manufacture, informs us that the high efficiency which the Edwards Pump gives when working as a "Wet" pump is principally due to the fact that there are always clear inlets for the air and incondensible gases to the barrel of the pump, also to the fact that there is no clearance space or passages in the Edwards pump, and to the "entrainment" action of the pump.

In comparison with the Dry Slide Valve Air Pump, Mr. Aitken attributes the success of the Edwards Pump when applied to "Torricellian" Condensers entirely to the two latter features which are wanting in pumps of the former type. The "no clearance" feature is one that can only be obtained in a pump in which a water-seal is possible. Mr. Aitken attaches much importance to the "entrainment" action of the Edwards Pump, which draws more air into the pump barrel than would otherwise naturally flow into it and increases the vacuum in the condenser. The air in the pump barrel being slightly compressed by the "entrainment" action, a smaller pump suffices to do the work than would otherwise be required.

It is interesting to note that the Hon. C. A. Parsons has adopted the "entrainment" principle in the Condenser and Air Pump in connection with his Turbine installations, in which a very high vacuum is desired.

We give particulars and illustrations of a few recent applications of the Edwards Pump to sugar manufacture.

Figure No. 1 shews a Set of Treble-barrelled Edwards Pumps, belt-driven. An important feature of the Edwards Pump is that it can be driven at a high speed without its efficiency being affected. Those pumps are 10 in. diameter × 8 in. stroke and run at 300

revolutions per minute. It will be observed that they are built on the enclosed principle, and are fitted with forced lubrication throughout.

Figure No. 2 shews a recent interesting development of the Edwards Pump in the form of a "Direct-acting" Steam Pump. The pumps shewn are 14 in. diameter × 10 in. stroke, and are designed to work at 60 double strokes per minute. The mechanism is so perfect that they have been tested at speeds varying from 10 to 140 double strokes per minute, and have worked with the utmost satisfaction throughout this large range of speed.

In the advertisement columns is shown an illustration of a Set of Treble-barrelled Edwards Pumps, steam-driven. These pumps replace and do the work of six vacuum pumps of the old type. A comparison of the volumetric capacity of the old pumps and steam cylinders with the new Edwards Pump installation is interesting. The ratio of pump capacity is as 2 to 1, and the ratio of steam cylinder capacity as about 5 to 1. These figures are remarkable, and besides the increase of efficiency of the pumps shew a great saving of power in favour of the Edwards Pump.

Perhaps one of the best criterions of the high standard of the Edwards Pump is that the largest sugar company in the world has adopted it as their standard vacuum pump.

REVIEW OF THE INSECT PESTS AFFECTING THE SUGAR CANE.*

By H. A. Ballou, B.Sc.,

Entomologist on the staff of the Imperial Department of Agriculture.

At the previous Conferences there have been presented papers on this subject, which, together with such other information as has come to hand from time to time, have appeared in the publications of the Imperial Department of Agriculture. This paper is intended to furnish a concise summary of what has been published, together with an account of a borer in canes (*Castnia licus*) which has recently appeared in British Guiana.

The Moth Borer.

(*Diatraea Saccharalis.*)

Life-history.—The egg is laid on the leaf; the larva lives about ten days in the outer leaf-sheath and then bores into the heart of the plant which, later, withers and dies. These withered shoots are known as dead hearts and are an indication of the presence of the larvae in a stool of canes. The larvae in a shoot may become well

* Read at the Agricultural Conference at Trinidad last January.

developed before the shoot withers; they also penetrate the stem of the cane, and may go from one shoot to another in the same stool. The larval life lasts from thirty to thirty-five days.

The pupa is formed in the tunnel made by the larva, near the surface of the cane, protected by a slight web across the mouth of the tunnel. The pupal period lasts about six days. The imago has a short existence, living but a few days. It is not a strong flyer, and remains inactive by day, flying at night. The female lays from 100 to 300 eggs.

Description.—The egg is flattened, oval, slightly convex, upper surface finely reticulate. The eggs are laid in clusters averaging about nineteen to a cluster, the range being from four to fifty-seven, usually between ten and thirty. When first laid they are light yellow, becoming orange-brown later, and just before hatching the centres become very dark. The egg is about 1 mm. ($\frac{1}{25}$ inch) in length.

The larva is about 2 mm. ($\frac{1}{12}$ inch) in length when first hatched, of a light-orange colour, with numerous short, black hairs. The mature larva is about $1\frac{1}{8}$ inches in length, the head is dark-brown or black, with a V-shaped mark lighter than the rest of the head. The pronotum is dark-brown or black. The remainder of the body whitish with stigmata black, and with a few dark hairs scattered over the body. The head and pronotum are hard, the remainder of the body being soft.

The pupa is naked, shiny brown, $\frac{1}{2}$ to $\frac{3}{4}$ inch in length, with short spines and callosities on abdominal segments.

The imago or moth is of a dull straw colour on upper surface of fore wings, with a few dark spots; the hind wings are whitish, under surface of wings uniformly light, the body brownish. The expanse of wings is $1\frac{1}{8}$ to $1\frac{3}{8}$ inches, length of body $\frac{5}{8}$ to $\frac{3}{4}$ inch.

Parasites.—The eggs are attacked by a small hymenopterous parasite (*Trichogramma pretiosa*), and the larvae are sometimes attacked by a fungus (*Cordyceps barberi*).

Injury to Canes.—The moth borer injures the cane in several ways: by killing the young shoots; by eating out the sugar-containing portion of the stem; and by affording easy access to fungoid diseases especially the rind disease (*Trichosphæria sacchari*).

Prevention.—Canes that show borer holes should not be planted, nor should such canes be sent from one estate or from one colony to another.

Remedies.—Cutting out the dead hearts seems to be the most generally practised of all remedial measures. These should be cut as low as possible to ensure getting below the larvae. The dead hearts are burned or fed to stock, and the larvae are thus destroyed. The collecting of eggs has been practised but does not seem to be generally carried out in the West Indies. Care should be taken to distinguish those eggs containing parasities: parasitized eggs should not be

burned with the others. but should be kept to give the parasites an opportunity of emerging.

Hard Back.

(*Ligyrus tumulosus.*)

This is the common black hard back, the larva of which is a white grub living in the ground feeding on vegetable matter. There seems to be no evidence that this is a serious pest to sugar cane, but a closely related species. *Ligyrus rugiceps*, is a pest of canes in Louisiana, and the West Indian form may do more harm than has been realized.

The Weevil Borer.

(*Sphenophorus sericeus.*)

Life-history.—The eggs are laid singly, embedded in the cane to a depth of $\frac{1}{6}$ inch. The egg hatches in four days, and the larva or grub eats its way into the cane, forming a small tunnel which increases in size as the larva grows larger. The larval period or grub stage lasts about seven weeks. During this period the larva destroys most of the interior of a joint of cane. The pupa is formed in the tunnel made by the larva and is covered with a large, rough cocoon made of the fibres of the cane. The pupal period lasts about ten days, and at the end of that time the adult beetle emerges from one end of the cocoon. The beetle is active, flying about at night. The female after mating, begins egg-laying which continues for some time. The beetles may be kept alive several weeks.

Description.—The egg is oval, about $\frac{1}{15}$ inch in length, and is nearly transparent.

The larva is a small, white grub when first hatched. It has no legs but has a hump near the hind end of the body by means of which it pushes itself along the tunnel. When full-grown the larva is about $\frac{1}{2}$-$\frac{5}{8}$ inch in length. and $\frac{3}{8}$ inch in thickness, at the swollen part of the hind body.

The pupa is soft. whitish, enclosed in a rough cocoon of coarse fibres in the rotten cane where the larva has lived.

The adult beetle is reddish-brown with black markings. There are three longitudinal black marks on the thorax, and the wing covers are edged with black, and on each wing cover there is a black line and black spot. The front of the head is produced to form a stout beak or snout. The length is about $\frac{1}{2}$ inch, the width about $\frac{3}{16}$ inch.

Injury to Canes.—The damage caused by this insect consists in the destruction of canes growing in the field, injury to young canes springing from cane plants, and possible injury to young canes springing from cane stumps.

Remedies and Prevention.—Destroy all infested canes, cover cut ends of cane plants, cane tops, and ratoon stumps with mould as soon as possible, or plant so that no ends shall be left exposed above ground, and destroy all stumps not intended for ratooning as soon as possible

after canes are cut. Tarring the ends of cane plants, as recommended for preventing fungoid attack, would probably be useful.

THE ROOT BORER.

(*Diaprepes abbreviatus.*)

Life-history.—Eggs are laid in clusters ranging in number from eight to 130 on upper side of leaf, not necessarily that of a food plant. When first laid, the eggs are white; later they become tinged with yellowish-brown. The eggs hatch in ten days. The newly hatched larva is about $\frac{1}{16}$ inch in length, pale yellowish-brown in colour. There are no legs, and the body is not swollen to form a hump like that seen in the larva of the weevil borer. The larvae or grubs fall to the ground and burrow beneath the surface. They begin feeding almost immediately on the roots of plants. They attack the canes first at the soft ends of the adventitious roots, the root stock being attacked later. The larva enters the cane about 9 to 11 inches below the surface of the ground, works its way upward several inches, then turns and descends and enters another cane. 'One grub is often responsible for the death of a whole stool of canes.'

The larval period extends over 300 to 312 days, and the mature larva measures $\frac{7}{8}$ to 1 inch in length, and $\frac{5}{16}$ to $\frac{3}{8}$ inch in diameter.

The pupa is formed in the ground where it is enclosed in an earthern cell, 6 or 8 inches below the surface, or in the cane, in which case it is enclosed in a cocoon similar to, but rougher than, that of the weevil borer, or in a nest of decaying leaves. The pupal period is about fifteen days.

The imago or adult beetle is at first soft and brownish-white. In two or three days it becomes hard and assumes its characteristic colours. The thorax is brownish with fine white pubescence, which gives a spotted appearance, wing covers greeenish-white with longitudinal brownish or bronze stripes; head brownish with stout snout or beak, the legs brownish, femora somewhat swollen.

The length of life of the adult is about twenty days, during which time mating and egg-laying occur. The female lays about 240 to 270 eggs.

Food Plants.—This insect is probably a very general feeder. It is known to feed on sugar cane, sweet potato, guinea corn, imphee, and ground nut, and has been found eating the roots of cacao trees in St. Lucia. (See *Agricultural News*, Vol. III, p. 264.)

Remedies,—Sweet potatos and imphee should not follow canes in field culture, nor should these be followed by canes. A crop not attacked by the root borer would be advisable, or no crop, with the removal of the cane stumps. The larvae of the root borer can live only about fifteen days without food, and to deprive them of food will be greatly to reduce their numbers. The following plants do not seem to be attacked by the root borer: ochro, cassava, yams, and eddoes, woolly pyrol, pigeon peas, bonavist, rouncival pea, bean.

(To be continued.)

THE MINERAL CONSTITUENTS OF THE SUGAR CANE.

By H. Pellet and Ch. Fribourg.

(Continued from page 287.)

If in the case of a single variety of cane examined at different periods of its growth we find such variations in composition, it is natural to suppose that when several varieties of cane are grown in the same soil, they will similarly vary in mineral composition, because they are not all equally ripe.

We can thus explain the tables of Dr. Maxwell and his colleagues, who have studied the mineral composition of the cane with a view to ascertaining what elements are absorbed from the soil, and consequently to deduce therefrom the nature of the manure to be applied. But it is also necessary to take into consideration the period that has elapsed since the canes were planted.

We know, for instance, that the cane when once planted will give ratoons for several subsequent years. There are instances indeed of canes giving good crops after 15 years; but generally they ought to be replanted after five or seven years. As regards Egypt, while certain fields may ratoon successfully for four years, they are generally replanted every two years. For these two crops the composition of the ash differs as indicated by the following figures:—

	Egyptian Canes. 1st year.	Egyptian Canes. 2nd year.
Phosphoric acid	9·5	11·4
Sulphuric acid	9·0	9·7
Chlorine	4·5	7·5
Lime	7·5	4·3
Magnesia	2·3	2·9
Potash	44·30	34·5

In conjunction with this, Messrs. Mackenzie and Foaden of the Agricultural School at Ghizeh (near Cairo) found—

Silica	26·90	Lime	4·80
Phosphoric acid	4·80	Magnesia	2·9
Sulphuric acid	6·50	Potash	34·3
Chlorine	8·10	Sodium	1·90

These gentlemen also recorded 9·80% peroxide of iron. Bonâme has published ash analyses of Guadaloupe canes which revealed striking differences in composition, in which the chief points to be noted are the high content in phosphoric acid, rising from 5·32 to 16·51%, the large proportion of lime and magnesia, and the comparatively small quantity of potash—namely, 8·67 to 14·23%. On the other hand the silica was from 35·87 to 49·77%.

This shows the importance of accurately noting the variety of the cane analysed, the time of planting and harvesting, and the degree of maturity. Moreover, in order to obtain reliable information as to the elements removed from the soil, it will not suffice to analyse a

few canes from one or more fields; we must take each day a sample in proportion to the quantity of canes worked up, and submit the resulting ash to a single analysis.

This general sample will, then, include all varieties of canes brought to the factory, those planted at different times and therefore of different degrees of maturity, also those harvested from soils which differ in physical and chemical composition; as well as ratoon canes of different years. Whether the ground is watered naturally or only by irrigation, or whether it receives water in both ways, should also be taken into consideration. After this manner we have tested Egyptian canes during the whole of one campaign. The mean sample exactly represented the bulk of the canes worked up, the canes being sliced for diffusion. The preparation of a mean sample of the whole cane presents serious difficulties, it being then necessary to split the canes lengthwise when reducing the size of the sample. Bonâme has shown that when the canes are cut up into two or three pieces, the percentage composition of each part varies appreciably, as follows:—

	Bottom.	Middle.	Top.	Average.
Silica	34·44	26·14	23·42	29·0
Phosphoric acid	14·88	12·82	9·07	12·30
Sulphuric acid	7·52	6·80	8·10	7·44
Chlorine	0·74	5·60	7·05	4·45
Lime	8·09	6·13	6·90	7·04
Magnesia	7·18	6·74	7·27	7·06
Potash	23·25	35·14	35·34	31·24
Sodium	0·38	0·12	2·42	0·97
Oxide of Iron	0·52	0·41	0·46	0·50

Bonâme has repeated these experiences in Mauritius with similar results.

It is mainly the proportion of mineral matter which varies with the period of maturity. For example:—

Canes planted in January, 1894.

1st Crop in May, 1895, after 14 months.
2nd ,, June ,, 15 ,,
3rd ,, July ,, 16 ,,
4th ,, August ,, 17 ,,
5th ,, September ,, 18 ,,
6th ,, October ,, 19 ,,

	Crops of May.	June.	July.	Aug.	Sept.	Oct.
Sugar per 100 gr. canes	9·56	9·94	12·26	13·14	13·70	11·50
Mineral matter per arpent*—Canes	102·84	196·87	111·68	121·31	115·06	141·90
Leaves	175·07	260·15	249·56	277·21	196·66	145·50
Total	277·91	457·02	361·14	398·52	311·22	287·40

* Arpent = from 1 to 1½ acres.

One sees that at a certain period there is a maximum absorption of mineral matter in the stems and leaves, and it is chiefly in the leaves that the subsequent loss of such matter occurs; this arises from the falling of the leaves when their function ceases.

We give below the mineral composition of the ash from the cane stems:—

	May.	June.	July.	August.	Sept.	Oct.
Silica	37·79	43·05	51·49	53·70	54·60	50·46
Chlorine	3·46	2·88	1·13	0·59	0·49	0·59
Sulphuric Acid	6·33	8·14	7·54	9·81	9·40	8·54
Phosphoric Acid	4·90	4·87	4·85	4·43	4·56	5·40
Lime	5·42	6·43	7·19	8·01	8·36	7·77
Magnesia	7·23	8	10·73	9·28	9·30	6·54
Potash	32·26	25·20	15·55	12·26	11·92	19·07
Sodium	1·22	0·52	0·50	0·33	0·49	0·55
Oxide of Iron	2·15	1·56	1·27	1·72	0·99	1·21
	100·77	100·65	100·25	100·13	100·11	100·13

From this it will be noticed that in 1895 Bonâme had not referred to the presence of alumina in cane ash. Also that the chlorine and potash diminish rapidly in proportion as the canes approach maturity. Finally, that the amount of phosphoric acid does not vary as much as in the other analyses made by this expert in Guadeloupe. We see that the mean composition is here very different to that of the four samples in which Bonâme found but 8·67 to 14·23% of potash; it approaches much more nearly to the figures of Dr. Maxwell and ourselves.

It is not therefore surprising to find analyses of cane ash with very small percentages of potash, when we consider the variations in the composition of the cane, due to differences in maturity and to the period which elapses between ripening and cropping. Notwithstanding this, we do not think that Popp's analyses represent the composition of canes under ordinary conditions.

These analyses (taken from Maumené's "Traité de la Fabrication de Sucre," t. II., p. 1876) are as follows:—

Per cent. gr. of Ash.	Canes.	Leaves.
Potash	7·66	10·65
Soda	6·45	3·26
Lime	12·53	8·19
Magnesia	6·61	2·45
Oxide of Iron	0·56	0·85
Silicic Acid	43·75	65·78
Phosphoric Acid	5·45	1·25
Sulphuric ,,	16·50	2·18
Carbonic ,,	—	3·55
Chlorine	0·23	1·65
	99·65	99·81

In conclusion we may say:—

1. In order to ascertain the mean composition of a variety of canes it is necessary to analyse a mean sample of the said variety which has been cultivated on a practical scale, the sample being fairly representative of the work of the factory.

2. For the same variety of cane the differences in the mineral composition of the ash, at different stages of maturity, may be greater than that in the case of two varieties planted on the same soil and cultivated under conditions as nearly identical as possible.

3. It is necessary to reconsider the question as to the presence or absence of alumina in vegetables generally and in the cane in particular.

4. As regards the estimation of titanium in the ash of vegetables we propose to publish the results of our studies very soon.

5. In order to completely understand the manurial requirements of the sugar cane it is necessary to ascertain the maximum quantity of mineral and nitrogenous matters absorbed by the whole cane. This maximum absorption does not coincide with the period of maturity, but occurs some time previously.

6. But to determine the quantity of mineral and nitrogenous matters removed from the soil under ordinary conditions, the analysis should be made on a sample collected during the entire working season.

The results obtained under 5 and 6 may be decidedly different; the former showing the maximum proportions of mineral and nitrogenous matters *required* by the growing crop; the latter indicating the material *actually* removed from the soil when the canes are sent to the factory.

CONSULAR REPORTS.

Columbia.

The cultivation of sugar cane was more than doubled in 1902, when the demand was great and the prices very high for molasses and muscovado sugar for local consumption, and the acreage occupied is a large proportion of the cultivated land. During the past year, however, prices have dropped more than 50 per cent., and the cost of labour remaining the same, many sugar cane planters have been obliged either to abandon their plantations or turn their cultivations into bananas or pastures.

United States.

New York.—There was a large increase in the importation of cane sugar, chiefly from Cuba and the East Indies. Imports from Germany increased, while those from the British West Indies diminished.

There was a demand for sugar for shipment to the United Kingdom at the end of the year, which has continued during the early months of 1905; this is met for the most part by Mexican sugar shipped from bond.

There is now one factory in the State of New York producing sugar from beets, and this sugar, with the assistance of a bounty of ½ c., or about ¼d. per lb., is able to compete with imported sugar in the home market, so long as the latter is subject to the duty levied on importation. As, however, a drawback of 99 per cent. is granted even when foreign sugar is refined in this country and then re-exported, the beet sugar manufactured in the State of New York is unable to compete in the export trade, and there are consequently no exports of this class of sugar.

The manufacture of beet sugar in the State of New York commenced in 1897, in which year a law was passed for the promotion of the culture of sugar beet, granting a bounty of not more than 1 c. per lb. for sugar made in accordance with the requirements, and appropriating about £5,000 for the purpose. Factories were to obtain a distributive share of this appropriation provided that all the beets they used were grown in the State of New York, that they did not grow their own beets but paid not less than 5 dol. (about £1) per ton for them, and that the sugar they produced contained not less than 90 per cent. of crystallised sugar. The policy declared at the time was to make direct appropriations from the State for a successive period of not less than five years in aid of the permanent establishment of the beet sugar industry in the State. The bounty was first fixed at a maximum of 1 c (½d.) per lb., and the appropriations increased from £5,000 in 1897 to £20,000 in 1901, but in the following year the appropriation was reduced to £10,000, and the bounty was also cut down to ½ c. (¼d.) per lb., at which figure it remains.

In 1897 a factory was set up at Rome in the State of New York, the machinery being imported from Canada; in 1898 a second factory was established at Binghamton, and in 1899 a third factory at Lyons; these seemed to do well at first and the central part of the State appeared to be well adapted to the culture of the sugar beet, but the industry made little progress. In 1900 the factory first established went into liquidation, the causes given being insufficiency of capital and difficulty in obtaining beets, and in 1904 the Binghamton factory removed to the State of Idaho, so that at the present time there is only one factory in operation in the State, namely, the Lyons Beet Sugar Refining Company, formerly the Empire State Sugar Company. The approximate amount of beet sugar manufactured of late years has been in 1899, 3,600 tons; in 1900, 6,000 tons; 1901, 4,050 tons; 1902, 2,800 tons; 1903, 4,400 tons; the estimate for 1904 is about 3,200 tons, the ton in each case being reckoned at 2,240 lbs.

JAVA.

The British Consul reports:—Generally speaking, the year 1904 may be regarded as having been a fairly prosperous one for the trade of the island of Java, a large increase in the sugar production more than compensating for shortages in the coffee and tobacco crops.

The steady increase of sugar during the past years has been well maintained, the total production amounting to 1,064,935 tons. Although this is attributable to a certain extent to the favourable weather, the most important factors have undoubtedly been the scientific application of artificial manures to the older grounds and the careful selection of the species of cane best adapted to the peculiarities of the various soils, resulting from a long series of experiments at the experimental stations at Pasoeroean and Pekalongan. These institutions have proved their value to the industry and are well supported by the planters.

Several of the new species of cane raised from seed in the nurseries of the East Java Experimental Station at Pasoeroean have been amongst the most productive. It is worthy of notice that a few of these species which have been reared from canes which have been in cultivation for more than 15 years, and have latterly been relegated to a minor portion of the fields, have proved to be the most fertile. This strengthens the faith placed in the seed cane generally, notwithstanding the disappointment some of the varieties have caused.

The process of cane selection still engrosses the attention of planters, and in many quarters it is believed that in this direction a means will be discovered further to enhance the production.

The following table gives the production in each of the past six years:—

Year.	Quantity. Tons.	Year.	Quantity. Tons.
1899	730,842	1902	848,021
1900	710,150	1903	883,020
1901	766,342	1904	1,064,935

During the year prices steadily advanced from the equivalent of 7s. to 9s. 4½d. per cwt.

A feature of the latter half of the year has been the inquiry for the 1905-06 sugar crop, the bulk of which has already passed out of planters' hands at satisfactory prices, ranging from the equivalent of 8s. 3d. to 11s. per cwt.

With regard to cane diseases, Mr. Acting Vice-Consul Rose reports as follows:—

"The well-known cane diseases still continue, but seem to be held in check by the measures now being rigorously and uninterruptedly

taken to extirpate them. The 'yellow stripe' disease, however, is one for which planters have as yet discovered no remedy. It appears to be propagated or retarded according to the weather conditions. At one period of the year it threatened to work havoc among the young canes, but fortunately an opportune change in the weather effected a complete recovery."

The profits of the past year's working are now in many cases being expended on new machinery, and in bringing the mills up to date, by which means planters hope to reduce the cost of production.

Reference to the accompanying table will show that up to the end of the year an all-round increase of the export to most countries has taken place. This is specially noticeable as regards shipments to the United Kingdom, India, and the United States. On account of the large sugar crops in Queensland and New South Wales proving sufficient for local requirements, Australia has only taken 14,000 tons of Java sugar as against 72,000 tons in 1903.

Although the exports to Singapore amount to 28,000 tons, there is reason to believe that a large portion of this is ultimately transhipped to Indian ports.

The sugar chiefly exported to India is what is known as superior sugar. It has there to a certain extent supplanted the Austro-Hungarian and German beet sugars.

Prospects for the 1905 crop are good, the young cane, according to reports, looking very well, but naturally much depends on the weather.

Exports of sugar crop for year ending December 31st, 1904, compared with the years 1902 and 1903 were as follows:—

Country.	Quantity. 1902. Tons.	1903. Tons.	1904. Tons.
United States	405,368	249,319	422,943
China	134,033	171,622	108,593
Japan	47,458	108,685	90,663
India	21,324	59,613	81,143
United Kingdom	35	26,126	55,511
British Columbia	10,648	10,868	16,732
Australia	71,717	72,096	14,000
Continent of Europe	1,596	1,302	4,565
Other countries	19,218	34,950	40,098
Total	711,397	734,581	834,248

Correspondence.

FIVE-ROLLER MILLS.

To the Editor of "The International Sugar Journal."

Dear Sir,—I notice some correspondence in your Journal regarding five-roller sugar mills, and as a practical sugar engineer beg to give my experience of this mill.

Do the firms who construct this mill realise the great drawbacks to the same? As in the five-roller mills that have come under my notice none of the five rollers are interchangeable with one another, so that in place of one spare roller with loose flanges, as required with the three-roller mill, to be safe with a five-roller mill you require five spare rollers, as all the shafts are different, and it is impossible to say which roller is likely to give way at any time. No doubt this is a point which must have escaped the notice of the purchasers of such mills. The power to drive a five-roller mill is naturally more than to drive a three-roller mill, which necessitates a larger engine, also much stronger gearing. The price of this mill is considerably higher than a three-roller mill, engine and gearing, and the planter would be much better to add so much more to his price, and by this means secure two three-roller mills and gearing, which can be driven by one engine; and in this case, as all the rollers and journals should be the same size, one spare roller with loose flanges would suit for any of the six rollers which might give way.

I would be pleased to know if John McNeil & Co., or the Harvey Engineering Co., Limited, have overcome the grave defect of the five-roller mill, namely, none of the rollers being interchangeable with each other.

Practical Sugar Engineer.

8th June, 1905.

To the Editor of "The International Sugar Journal."

Sir,—If the letter in the June number of *The International Sugar Journal* from the Harvey Engineering Company, Ld., had stopped at their claim to have made the first five-roller mill to the design of Thomson & Black, Campos, Brazil, I should have taken no objection to it, but the gracious imputation that follows, implying that my firm is but of yesterday, requires some notice from me, which I trust you will be good enough to find space for.

The statement that I object to is: "The first five-roller mill was constructed by us in the year 1881, *before Messrs. McNeil's firm was in existence*," and I object to it for the plain reason that it is not true; the facts are just the other way about.

The present Directors of the Harvey Engineering Company, Ld., may be excused for ignorance of the events of 1881, but their Secretary, my clever colleague of those days, might have been better advised than attempt a perversion of dates within my own experience. I am well entitled to know that my firm, then Aitken, McNeil & Co., began business on October 1st, 1881, and he ought to know that that was before their first five-roller mill was in existence.

Had the present partners known the early history of this mill they would not likely be eager to claim the honour of its introduction, and evidently it will be news to them to learn that their predecessors did not only not appreciate it, but they did all in their power to discourage the patentees as to its possibilities; in fact they only shewed some consideration for it after they learned that my firm had secured orders for such mills.

Then in regard to the Jamaica Exhibition they are again at fault, for Aitken, McNeil & Co. had there a model mill of this type, and although the McOnie mill was awarded a medal, whilst our little model was not so lucky, the honours in the long run were clearly in our favour, as may be judged by the business results.

The last mail from Jamaica brought word that an increased output of 100 tons sugar on one estate was being put to the credit of McNeil's five-roller mill, and from Barbados a gain of 50 tons is credited to a smaller mill of that design.

"Practical Sugar Engineer," who writes you this month, speaks of his experience of the five-roller mill, but confines his remarks to the question of spare rollers, the price of such mills, and the power required to drive them.

Let me assure him that it is quite easy to build this type of mill with its three grinding rollers interchangeable, and the two splitting rollers interchangeable also, although after more than twenty years' working the failure of a splitting roller is an almost unknown incident.

As regards the greater price and power required for a five-roller mill, I should not think these mattered much if a good return was obtained from them in the form of higher extraction, for after all that is what the mill is there for.

"Practical Sugar Engineer" admits that a six-roller mill will cost more than a five-roller one, but stops short of claiming that the extra outlay will ensure a correspondingly increased juice extraction.

Yours faithfully,

J. McNeil.

24th June, 1905.

MONTHLY LIST OF PATENTS.

Communicated by Mr. W. P. THOMPSON, C.E., F.C.S., M.I.M.E., Chartered Patent Agent, 6, Lord Street, Liverpool; and 322, High Holborn, London.

ENGLISH.—APPLICATIONS.

9869. G. STOFF, Berlin, W., Germany. *Improvements in machines for drawing sugar for bon-bons and the like.* Complete specification. 10th May, 1905.

9923. R. HARVEY, Glasgow (communicated by J. P. Rodriguez, Cuba). *Improvements in and relating to mills for crushing sugar cane or like material.* 11th May, 1905.

10273. H. ROY, London. *Improvements in or relating to the treatment of masse-cuite and in apparatus therefor.* (Date applied for under Patents Act, 1901; 16th May, 1904, being date of application in France.) Complete specification. 16th May, 1905.

11497. O. LUGO, London. *Improvement in processes for the preservation of unfermented natural saccharine fruit-juices.* 1st June, 1905.

ABRIDGMENTS.

15934. Dr. C. STIEPEL, Berlin, Germany. *Improved manufacture of betaine and its salts from the molasses and waste products of beetroot sugar manufacture.* 18th July, 1904. This invention relates to the manufacture of betaine and its salts from the molasses and waste products of beetroot sugar manufacture by extracting the crude material with alcohol, and separating the betaine from the alcoholic solution either by evaporating the alcohol or by converting the betaine into a suitable salt.

NOTE.—Copies of all published specifications with their drawings in these lists can be obtained from W. P. Thompson & Co., 6, Lord Street, Liverpool, at One Shilling a copy for English or American Patents, and Two Shillings for German. In ordering please give number and date.

IMPORTS AND EXPORTS OF SUGAR (UNITED KINGDOM)

To end of May, 1904 and 1905.

IMPORTS.

Raw Sugars.	Quantities. 1904. Cwts.	Quantities. 1905. Cwts.	Values. 1904. £	Values. 1905. £
Germany	3,013,065	1,185,583	1,313,289	806,089
Holland	75,204	74,451	30,798	54,731
Belgium	155,266	270,852	65,672	203,756
France	95,880	77,747	42,957	57,718
Austria-Hungary	659,135	223,942	298,846	165,062
Java	706,743	1,254,567	298,891	931,101
Philippine Islands	....	....	....	....
Cuba	....	....	....	....
Peru	403,263	665,869	180,322	488,810
Brazil	81,115	27,828	30,996	18,087
Argentine Republic	....	....	....	....
Mauritius	158,680	134,997	59,258	76,142
British East Indies	98,108	278,049	38,954	146,654
Br. W. Indies, Guiana, &c.	570,397	647,037	370,997	522,265
Other Countries	322,217	570,365	146,541	412,510
Total Raw Sugars	6,339,073	5,411,287	2,877,521	3,912,925
Refined Sugars.				
Germany	4,633,766	3,841,230	2,583,508	3,283,435
Holland	1,331,958	544,799	778,013	483,985
Belgium	189,707	112,429	106,734	98,578
France	953,384	500,011	512,005	433,598
Other Countries	162,142	230,996	85,683	189,372
Total Refined Sugars	7,270,957	5,229,465	4,065,943	4,488,968
Molasses	770,240	930,379	136,491	197,107
Total Imports	14,380,270	11,571,131	7,079,955	8,599,000

EXPORTS.

British Refined Sugars.	Cwts.	Cwts.	£	£
Sweden and Norway	10,939	8,431	5,531	7,092
Denmark	46,158	27,636	23,632	21,898
Holland	24,861	30,619	12,937	25,666
Belgium	4,425	2,459	2,413	1,863
Portugal, Azores, &c.	5,180	6,568	2,734	5,233
Italy	1,727	726	810	546
Other Countries	134,574	92,583	83,147	88,684
	227,864	169,022	131,204	150,982
Foreign & Colonial Sugars.				
Refined and Candy	11,354	7,162	7,770	7,035
Unrefined	47,594	20,784	25,976	16,584
Molasses	144	419	60	204
Total Exports	286,956	197,387	165,010	174,805

UNITED STATES.

(Willett & Gray, &c.)

(Tons of 2,240 lbs.)	1905. Tons.		1904. Tons.
Total Receipts, Jan. 1st to June 22nd ..	923,985	..	999,044
Receipts of Refined ,, ,, ,, ..	698	..	225
Deliveries ,, ,, ,, ..	854,972	..	984,708
Consumption	763,555	..	835,792
Importers' Stocks June 21st	69,013	..	26,497
Total Stocks, June 28th	228,000	..	205,996
Stocks in Cuba, ,, ...	334,000	..	150,385
	1904.		1903.
Total Consumption for twelve months ..	2,727,162	..	2,549,643

CUBA.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1904 AND 1905.

(Tons of 2,240lbs.)	1904. Tons.		1905. Tons.
Exports	775,327	..	633,641
Stocks	236,942	..	381,509
	1,012,269	..	1,015,150
Local Consumption (five months)	18,240	..	19,130
	1,030,509	..	1,034,280
Stock on 1st January (old crop)	94,835	..	—
Receipts at Ports up to May 31st	935,674	..	1,034,280

Havana, 31st May, 1905.

J. GUMA.—F. MEJER.

UNITED KINGDOM.

STATEMENT OF IMPORTS, EXPORTS, AND CONSUMPTION FOR FIVE MONTHS ENDING MAY 31ST.

SUGAR.	Imports. 1903. Tons.		Imports. 1904. Tons.		Imports. 1905. Tons.	Exports (Foreign). 1903. Tons.		Exports (Foreign). 1904. Tons.		Exports (Foreign). 1905. Tons.
Refined	366,874	..	363,548	..	261,473	654	..	568	..	358
Raw	241,516	..	316,954	..	270,564	1,194	..	2,380	..	1,039
Molasses	31,516	..	38,512	..	46,519	56	..	7	..	21
Total..........	639,906	..	716,014	..	578,556	1,904	..	2,955	..	1,418

	Home Consumption. 1903. Tons.		Home Consumption. 1904. Tons.		Home Consumption. 1905. Tons.
Refined	343,401	..	377,955	..	259,130
Refined (in Bond) in the United Kingdom	—	..	209,354	..	206,878
Raw	224,037	..	51,355	..	41,438
Molasses	29,600	..	33,873	..	45,854
Molasses, manufactured (in Bond) in U.K.	—	..	26,866	..	22,103
Total	597,038	..	699,403	..	575,403
Less Exports of British Refined.....................	14,304	..	11,393	..	8,451
Total Home Consumption of Sugar	582,734	..	688,010	..	566,952

STOCKS OF SUGAR IN EUROPE AT UNEVEN DATES, JUNE 1ST TO 28TH, COMPARED WITH PREVIOUS YEARS.

IN THOUSANDS OF TONS, TO THE NEAREST THOUSAND.

Great Britain.	Germany including Hamburg.	France.	Austria.	Holland and Belgium.	TOTAL 1905.
163	649	478	315	80	1685

	1904.	1903.	1902.	1901.
Totals	2259 ..	2239 ..	2380 ..	1510

TWELVE MONTHS' CONSUMPTION OF SUGAR IN EUROPE FOR THREE YEARS, ENDING MAY 31ST, IN THOUSANDS OF TONS.

(Licht's Circular.)

Great Britain.	Germany.	France.	Austria.	Holland, Belgium, &c.	Total 1904-5.	Total 1903-4.	Total 1902-3.
1617	1020	644	467	184	3932	4022	3419

ESTIMATED CROP OF BEETROOT SUGAR ON THE CONTINENT OF EUROPE FOR THE CURRENT CAMPAIGN, COMPARED WITH THE ACTUAL CROP OF THE THREE PREVIOUS CAMPAIGNS.

(From Licht's Monthly Circular.)

	1904-1905. Tons.	1903-1904. Tons.	1902-1903. Tons.	1901-1902. Tons.
Germany	1,575,000 ..	1,927,681 ..	1.762,461 ..	2,304,923
Austria	893;000 ..	1,167,959 ..	1,057,692 ..	1,301,549
France	625,000 ..	804,308 ..	833,210 ..	1,123,533
Russia	940,000 ..	1,206,907 ..	1,256,311 ..	1,098,983
Belgium	173,000 ..	203,446 ..	224,090 ..	334,960
Holland	135,000 ..	123,551 ..	102,411 ..	203,172
Other Countries .	340,000 ..	441,116 ..	325,082 ..	393,236
	4,681,000	5,874,968	5,561,257	6,760,356

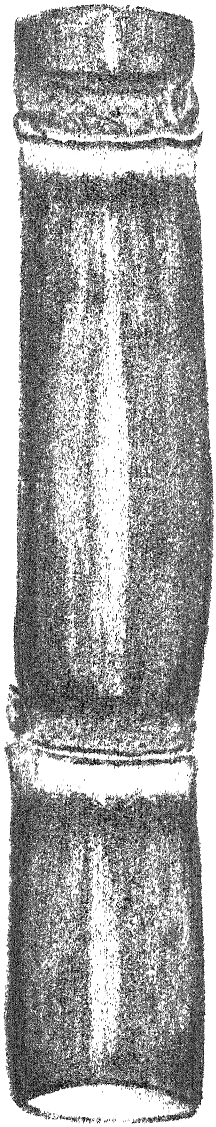


FIG. 10.
ISCAMBINE.

3/4 SIZE

Specimen

Plate

in

NOËL DEERR'S

SUGAR . . .

AND THE . .

SUGAR CANE.

(See over.)

THE

INTERNATIONAL

SUGAR JOURNAL.

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☞ All communications to be addressed to The Editor, Office of *The Sugar Cane*, Altrincham, near Manchester.

All Advertisements to be sent *direct*.

Cheques and Postal Orders to be made payable to Norman Rodger, Altrincham.

☞ The Editor is not responsible for statements or opinions contained in articles which are signed, or the source of which is named.

NOTES AND COMMENTS.

New Central Sugar Factory in St. Croix.

In *The St. Croix Avis*, of Christiansted, St. Croix, Danish West Indies, of 24th May, 1905, there is an article describing a visit paid by one of its editors to the new Central Sugar Factory in Lower Bethlehem on the road from Christiansted to Fredericksted. This factory is owned by Messrs. Lachmann, who gained a part of their great fortune by the exploitation of the sugar industry of Sweden. The installation of the whole machinery and the ironwork of the buildings was undertaken by the Breitfeld Danek Engineering Co., of Prague, Bohemia, and the editor of the article, who was inspired by Mr. Lachmann himself, is full of praise of the Bohemian firm who produced the machinery, as also of the two Bohemian engineers who undertook the erection and the starting of the whole. This having been only recently effected, it is still impossible to speak about the results of the first campaign at the first Central Sugar Factory in St. Croix. The writer of the notice points out that the installation includes four boilers of a special system fitted with two furnaces each for burning bagasse (no other combustible being necessary), the whole being erected in an iron building with brick walls; no wood is used in the construction. At present two cane mills effect the extraction

of the juice; but a new maceration process will shortly be put on trial. Two special engines operate two sets of pumps which are sufficient for the whole service.

After being defecated and filtered in the filter-presses, the juice is conveyed to a battery of sand-filters working without pressure, then it passes to the evaporating station consisting of a quintuple-effet. From here the juice is conveyed again to the sand-filters, then to the vacuum pans. The masse-cuite is cooled in large refrigerators with stirrers and finally centrifugalled.

We hope to publish later a technical description of this modern factory and to be able to furnish our readers with the results obtained in respect to economical working.

The Antigua Centrale.

The Antigua Central Sugar Factory has just finished its first campaign. We learn that the working of the factory has been thoroughly satisfactory, and everything has gone smoothly, apart from some temporary hitches in minor details which were put right without much delay. Unfortunately the prolonged drought, resulting in a disastrously small crop, has prevented the year's working showing the commercial results that would otherwise have been expected. We, however, hope next year's crop will be more abundant and will enable the factory to show what it is really capable of doing.

The papers by Mr. H. C. Prinsen Geerligs which appeared in our pages last autumn on the *Chemical Control in Use in the Java Sugar Factories* have now been re-printed in book form, with the addition of numerous tables and Factory Book models. The whole will form a valuable reference book for Factory Chemists and Managers. Particulars as to the publication will be found in our advertisement columns.

The Natal Government is prepared to receive proposals from persons or companies desirous of erecting and working a central sugar factory in the coastland of Zululand. The details of the scheme are left to proposers. No guarantee of interest of capital will be entertained. Lessees of the lands shortly to be allotted will be required, upon their leases, to plant cane for the mill, and the proposals now invited should provide for accepting delivery at or near to the lots.

THE BRUSSELS SUGAR COMMISSION.

(*Continued from page 319.*)

Sir Henry Bergne's Report (Continued).

The next business before the Commission was a re-examination of the decisions of the Commission in regard to the Argentine Republic, Brazil, and the Dominican Republic.

The Argentine Republic.—It will be recollected that at the twenty-first sitting of the Commission it was decided that, until the Permanent Bureau had procured more complete information, the rate of countervailing duty fixed by the United States at 50 fr. per 100 kilog. for Argentine sugar, should be adopted by the Contracting States.

At the twenty-seventh sitting, held on the 15th March, 1904, a calculation was made as to the proper rate of countervailing duty as follows:—

	Per 100 kilog. Fr. c.
Refined sugar	19 90
Unrefined	15 5
Candied	10 50

It was, however, then thought necessary to obtain still further information before actually adopting this rate, and, as a provisional measure, the rate fixed by the United States was in the meanwhile maintained by the Commission.

The Commission at its recent session had before it an Argentine Law of the 30th January, 1904, which provides that from the 1st January, 1905, 25 per cent. of the national production of sugar will pay a tax of 15 centavos per kilogramme; a drawback equal to the tax being accorded to sugar exported up to 25 per cent. of the production.

Article V. of the same Law, however, provides that each time the wholesale price of sugar of national production shall reach 3 pesos per 10 kilog., placed on waggon at the factory and comprising the tax paid, or when the situation of the internal market shall require it for regularisation, the Executive Power may—

(*a.*) Increase to more than 75 per cent. the quantity of sugar not subject to the tax.

(*b.*) Increase to more than 25 per cent. the quantity subjected to the tax of 15 centavos.

(*c.*) Lower or suppress the quantity fixed in Article II.

(*d.*) Diminish for a sufficient time the customs duties.

Bearing in mind the high surtax in the Argentine Republic, it is evident that this law has the effect of a bounty, since it artificially

stimulates home production and prices, with the view to exportation on terms more favourable than could be secured without such legislative interference with the natural conditions of the market.

When, therefore, the question came to be discussed by the Commission, the various delegations came unanimously to the conclusion that the Argentine system resulted in a bounty.

In these circumstances the Permanent Bureau suggested that the rates of countervailing duties mentioned above as having been calculated at the twenty-seventh sitting, held on the 15th March, 1904, should be adopted, and the Commission accepted this suggestion.

I stated, however, that as Great Britain proceeded by the method of prohibition, the rate of countervailing duty was not of immediate interest to us, but I must nevertheless reserve my opinion as to whether the exact rate thus adopted was correct or not.

It may not be out of place here to mention that, according to information received by the Permanent Bureau, Argentine sugars are now subjected in the United States to a countervailing duty of 56 fr. 25 c. per 100 kilog., the duty of 50 fr. per 100 kilog. previously fixed having lately been increased. It may be noted that in the United States the existence of a high surtax alone is not considered sufficient to justify the imposition of countervailing duties, which are only applied to sugars from countries which give bounties.

Brazil.—In October, 1904, the Brazilian Government had asked for a delay of twelve months, in order to examine the situation of the sugar industry, within which time they desired that the decision of the Commission should not be applied to Brazilian sugar. The German Government signified its readiness to accede to this proposal, and when the Commission came to consider the suggestion, I supported it, adding that the information received by His Majesty's Government tended to show that no bounty existed in Brazil. For example, the exportations showed a steady diminution from 187,000 tons in 1901 to only 8,000 tons in 1904. If the delay were granted, it would be necessary to suspend the decision of the Commission arrived at last session, which was not based on any arguments showing the existence of a bounty.

It was argued in reply that certain prizes or premiums granted in the State of Alagoas were of the nature of bounties; but it was pointed out that there was no evidence that the law granting these had been put in operation. The Commission eventually decided unanimously to suspend its previous decision until clear information could be obtained as to whether the surtax existing in Brazil was used in such a manner as to give rise to a bounty.

The Dominican Republic was next considered. The Permanent Bureau reported that by Decree of the 5th December, 1904, the duty on raw and refined sugar had been reduced to 2 fr. 75 c. and 5 fr. 50 c.

per 100 kilog. respectively. There was, therefore, no occasion any longer to apply countervailing duties. It was true that Article II. of the Decree provided for a possible increase in the duties of about 1 fr. 10 c. per 100 kilog.; but even in that case the surtax would not appreciably exceed the Conventional limit, and it could therefore be ignored. These conclusions were accepted by the Commission.

The Commission then proceeded to examine the laws of Cuba, the United States, and Porto Rico.

Cuba.—The Permanent Bureau gave certain information as to the production, consumption, and exportation of sugar, and recalled the fact that at the twenty-sixth sitting, on the 14th March, 1904, the Bureau had proposed to fix rates of countervailing duty for Cuban sugar at 5 fr. 86 c. for raw, and 11 fr. 35 c. for refined, per 100 kilog.

The British delegation replied by the following argument:—

"*Sir Henry Bergne* recalls the fact that he has more than once shown that, in view of the small consumption of sugar in Cuba and the largeness of the export, it is impossible that a bounty can arise from the surtax; it is evident that with a consumption amounting to only four per cent. of the export, the internal sale of sugar cannot realise a profit sufficient to result in a bounty on the sugar exported.

"According to reports from the British Minister at Havana, the internal price of sugar on the Cuban markets does not appreciably differ from the price of sugar for export. His Majesty's Minister also states that there does not exist in the island any association for maintaining prices in the home market.

"In these circumstances it seems evident that the existing surtax, although in excess of that fixed by Article III. of the Convention, cannot give rise to a bounty.

"The Cuban Government gives no bounty on export, nor any drawback on the exportation of sugar or of sugared products.

"It appears that a proposal will shortly be laid before the Cuban Congress, for reducing to within the limits fixed by Article III. of the Convention, the duty on imported sugar (there are no excise duties). The present duty on sugar imported from all countries other than the United States is 1½ cents per pound on raw sugar, and 2½ cents per pound on refined; the United States enjoy a reduced tariff.

"The British Delegate communicates to the Commission the following figures respecting the production and consumption of sugar in Cuba during recent years, taken from returns published by the Havana brokers:—

Campaign commencing 1st December.	Production. Tons of 2,240 lbs.	Consumption. Tons of 2,240 lbs.
1899-1900	300,075	37,500
1900-1901	635,856	38,600
1901-1902	851,181	40,250
1902-1903	998,878	39,570
1903-1904	1,040,228	44,320

"The following figures respecting importation and exportation are taken from Cuban official returns:—

Year		Raw Sugar. Tons.	Refined Sugar. Tons.	Candied Sugar and Confectioneries. Tons.
1899	Importation	*	157	464
	Exportation	317,211	30	*
1900	Importation	*	240	447
	Exportation	286,917	15	*
1901	Importation	*	375	451
	Exportation	589,159	36	*
1902	Importation	*	199	364
	Exportation	795,278	62	*
1903	Importation	*	101	316
	Exportation	945,633	27	*

"The British Delegate is of opinion that, in view of the foregoing facts, there is no need to fix a countervailing duty for sugars from Cuba, since it is evident that no bounty can arise in such circumstances."

The question was raised whether the preference given in the United States constitutes a bounty on Cuban sugars.

To this the British delegation replied as follows:—

"*Sir H. Bergne* says that it is true that sugar imported from Cuba into the United States of America obtains a preference of 20 per cent. as regards import duties over sugar from other sources. The opinion has been expressed that the privilege thus accorded to Cuban sugar is of the nature of a bounty. This view seems based on the assumption that this preferential treatment secures to Cuban sugar a market which enables Cuba to throw her surplus production on the other markets at inferior prices.

"It seems impossible to maintain that preferential treatment granted by a third country must be considered as a bounty. The Convention has in view sugar which receives bounties derived from the action of the Government of the country of origin, and not sugar which enjoys advantages due to the legislation of other countries.

"It might, perhaps, be said that the Philippines, and in a certain measure Cuba, enjoy advantages through the action of a State which in some measure plays the part of the mother-country. Nevertheless, the Commission cannot consider that advantages of this kind are equivalent to bounties, seeing that France is at liberty to grant a preference to sugar from her Colonies, who pay only the excise duty of 25 fr., without the surtax (5·50 or 6 fr.) paid by sugar from foreign countries. The Commission has likewise decided to this effect in the case of the Portuguese possessions.

"Putting aside these general considerations, it is evident that the preference granted by the United States is not sufficient to allow the producers of sugar in Cuba and the Philippines to take advantage of the market which the United States offer them in order to export sugar to other markets at a lower price.

* The exportations of candied sugar and of confectionery are quoted only in values. They were 1,819*l*. in 1899; 3,768*l*. in 1900; 3,004*l*. in 1901; 3,324*l*. in 1902; and 4,097*l*. in 1903.

"It is permissible under the Convention to secure the home market to the producer by means of a surtax of 6 fr. per 100 kilog. on refined sugar, and 5·50 fr. on raw sugar. In the case under consideration it has been shown that the preference to Cuba amounts only to a fifth of the duties applied by the United States to foreign sugars. Now the duty on refined sugar in the United States is 1·95 cents per pound, and the fifth part of this duty is equivalent to only about 4·50 fr. per 100 kilog. The duty on raw sugar is much lower. There cannot, therefore, in accordance with the spirit of Article III. of the Convention, be any question of an indirect bounty on Cuban sugars."

I added that the argument that the receipts of preference in another market constitutes a bounty, would lead to the conclusion that any Treaty of Commerce which might be concluded between two countries, granting favourable terms as to customs duties on sugar, might be adjudged to create bounties—a proposition which was perfectly inadmissible.

The Commission eventually decided that the consideration of the question of Cuba should be adjourned, there being no present need to fix any countervailing duties for Cuban sugars.

United States.—The Permanent Bureau had obtained a certain amount of information as to importation, production, consumption, and prices of sugar in the United States.

The British delegation had also circulated to the members of the Commission a statement concerning the sugar industry in the United States, in which it was pointed out that the figures published by the Permanent Bureau proved that the enormous consumption of sugar in the United States is only supplied to a small extent by native-grown sugar, which is, and is likely to be in the future, wholly inadequate to supply the increasing demands of the population.

The prices of sugar in the American market were therefore determined by those of imported sugar, and in these circumstances the high duty could not give rise to a bounty on exportation.

No sugar of native growth is exported from the United States, such exports as there are consisting of imported sugar refined in the United States and exported with benefit of drawback. Under the drawback system the exporter of sugar refined from imported raw sugar secures the return of 99 per cent. of the import duty paid on the raw sugar. It is evident, therefore, that such exportation could not be in any way stimulated by the magnitude of the import duty, the system, if rigorously administered, being from this point of view similar to refining in bond. The fact that the drawback system only applies to sugar refined from imported raw sugar is sufficient to prevent any sugar of native production being exported.

Particulars were also given of the bounty granted on beet sugar production in New York State, the only State which now gives such a bounty. At the present time only one factory enjoys the bounty

of half a cent. per pound, the production benefiting therefrom in 1904 being estimated at 3,214 tons. None of this sugar is exported, and the amount is infinitesimal compared with the total consumption in the United States.

To this I added that certificates of origin were required for all sugars entering the United Kingdom, in such a form as to render it impossible that any bountied sugar could be received from the United States.

After some discussion it was recognised that, considering the United States import four-fifths of the sugar they consume, the question of fixing countervailing duties at the present moment has theoretical rather than practical importance, and the Commission therefore decided to adjourn the consideration of the United States' system, on the understanding, which, indeed, has always subsisted, that it was within the right of any of the Contracting States to summon a special meeting of the Commission to consider any fresh development which might be considered to be of an urgent character.

Porto Rico.—The Permanent Bureau produced certain particulars as to production, consumption, exportation, and prices in this island, and on the motion of the President it was decided to adjourn also the consideration of Porto Rico, in view of its customs connection with the United States.

An examination into the laws of the following countries was next commenced:—

Mexico.—The Permanent Bureau produced some additional information in regard to this country, showing that Mexico had reduced its surtax to about 6 fr. per 100 kilog. There was therefore no occasion to apply countervailing duties to Mexican sugar. The Commission consequently decided unanimously in that sense.

Uruguay.—The Permanent Bureau reported that there was no production of sugar in this country, and therefore no exportation. There was consequently no reason to impose countervailing duties. This conclusion was unanimously accepted by the Commission.

Venezuela.—The Permanent Bureau reported that there was no exportation of sugar, and consequently no reason to impose countervailing duties. This conclusion was unanimously accepted by the Commission.

In recapitulation it is to be observed that during this session of the Commission countervailing duties have not been fixed as applicable to any further countries. There was therefore no need to insist upon any special formula being used in cases where rates of countervailing duty may be fixed in regard only to the existence of a high surtax, without consideration whether such surtax leads to a bounty or not.

The final sitting, the thirty-ninth, was devoted to the consideration of the application of Switzerland to be admitted to the Convention on special terms. The diplomatic correspondence which had passed on this subject was read, and it was decided that the matter, being one not within the competence of the Commission, must be left to be settled through the diplomatic channel.

At this session a distinct understanding was arrived at, that the Permanent Bureau should in future undertake to collect and present to the Commission full information in regard to the circumstances of each country that may come under discussion, in order that the Commission may be placed in possession of sufficient data to enable a proper judgment to be formed as to whether a bounty really exists or not.

I think it my duty to report that the representations which I was called upon to make to the Commission on behalf of His Majesty's Government were received with much courtesy and consideration; and that the President, M. Capelle, was always ready, with conspicuous tact and ability, to prevent any possible friction, and to seek a practical solution of any difficulties that arose.

To my colleagues of the British delegation I again owe my best thanks for assistance and advice, and especially to Mr. Llewellyn Smith, C.B., without whose admirable method in collecting and preparing the evidence in support of the appeal of His Majesty's Government, it would have been impossible to have adequately presented the facts.

The next session of the Commission has been fixed for the 23rd October, 1905, unless specially summoned on some matter of urgent importance.

I have, &c.,

(Signed) H. G. BERGNE.

Messrs. Fawcett, Preston & Co., Ltd., of Liverpool, the well-known Sugar Machinery Engineers, have just re-constructed their Company, doubtless with a view to increasing their business.

There has been a considerable drop in the exports from Germany to Canada the last twelve months. In particular, the German sugar industry has suffered by the change; whereas up to 1903 Germany supplied nearly half of the Canadian sugar requirements, no raw sugar exports took place in 1904. Excluding a few articles in which German exports to Canada have slightly increased, British trade, it is satisfactory to note, has almost everywhere superseded the German trade.

SIMPLE METHODS OF CHEMICAL CONTROL.

By T. H. P. Heriot, F.C.S.

(Continued from page 326.)

II.

Fitting up the Laboratory, &c.

As the mechanic requires a working bench and a place to keep his tools, so the chemist will require accommodation for his apparatus and a few conveniences to facilitate his work. A fair amount of light, a supply of clean water, and absence from vibrations and artificial sources of heat are the main essentials; proximity to the factory need only be considered when erecting a special building. A suitable room may generally be found either in the manager's house or the overseers' quarters; or a portion of the general office may be partitioned off. The room should be used for no other purpose and therefore kept under lock and key.

The furniture should be plain but strong, and should comprise two tables (about 3 ft. 6 in. × 2 ft. 6 in.); one table (about 2 ft. 6 in. × 1 ft. 6 in.) and a couple of stools or chairs. The estate's carpenter may adapt these for certain special purposes.

1. *The Sink.*—The small table is converted into a sink in the following manner. A piece of sheet-lead, large enough to overlap the top of the table by 4 in. on every side, is thoroughly flattened out upon it, and the overlapping portions turned down along the edges, the lead being neatly folded at the corners, without cutting. A shallow lead tray (in an inverted position) is thus moulded to the dimensions of the table, after which it is carefully removed and placed on one side. Turning to the table, a central depression (3 in. diameter and ½ in. deep) is cut in the top, and in the centre of this depression a 1¼ in. hole is bored right through. The top of the table is next fitted with a projecting vertical ledge to support the sides of the lead tray, but as the latter is slightly larger than the table (*i.e.*, by twice the thickness of the lead sheet) suitable "distance pieces" must first be tacked to the edges of the table. Four boards (about 5 in. wide and 1 in. thick) are next screwed to the "distance pieces" so as to project 4 in. above the top of the table. All is now ready for the lead tray, which should exactly fit the support prepared for it, and only requires to be nailed to the side supports.

The lead is gently hammered into the depression cut into the table so that the joint with the waste pipe may be counter-sunk, and a neat hole cut in the lead to correspond with that in the table. A piece of compo-piping, to fit this hole, is inserted so as to project ¼ in. above the lead, this part being expanded and hammered out to form

a flange, which must then be soldered to the sheet lead. The completed sink will then have the appearance shown in *Fig. 1* (the sides of the sink being vertical).

The convenience of connecting the sink with a water supply, and of extending the waste pipe into a drain will be obvious, otherwise one must be content with a bucket of clean water provided with a dipper and an empty bucket below to receive the waste. The sink should be placed against the wall and in a good light.

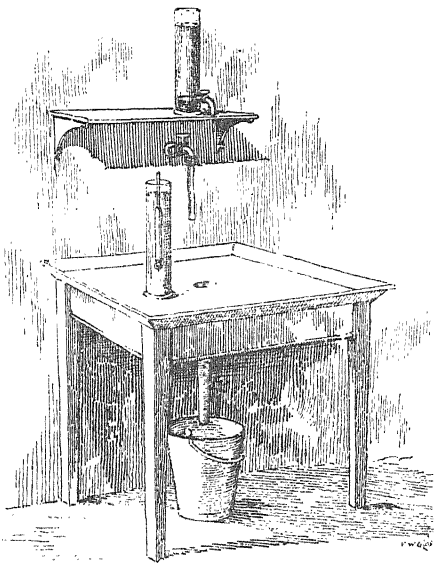

Fig. 1.—The Sink.

2. *Draining Racks.*—Time and trouble can be saved by allowing apparatus to drain until quite dry after being washed. For this purpose two shelves should be fixed to the wall, one above the other, so as to project over the sink. The lower shelf about 8 in. above the sink, is pierced with a row of $\frac{3}{4}$ in. holes at distances of about $1\frac{1}{2}$ in. apart; these holes being large enough to admit the neck of an inverted measure flask.

The second shelf should be fixed about 12 in. above the lower one, and project beyond it, and is provided with a row of slots, $1\frac{3}{4}$ in. deep (from the front), $1\frac{1}{2}$ in. wide, and with spaces of $1\frac{1}{2}$ in. between each slot. These slots admit an inverted hydrometer cylinder, the foot of which being wider than the slot is supported by the shelf.

3. *Polariscope Screen.*—One of the two larger tables is reserved exclusively for the polariscope. As this instrument is operated by

artificial light and it is desirable to exclude daylight, this table should be placed against the wall in a corner of the room. It may then be screened off by a curtain of dark coloured serge, about 4 ft. wide (*i.e.*, a little wider than the length of the table) and sufficiently long to reach from the ceiling to the floor. The table is thus enclosed on three sides, leaving one end open, at which the observer sits. Here it will be advisable to put up a shorter curtain, reaching only to the top of the table and of the same width as the latter.

4. *Shelves, &c.*—One or two narrow shelves are required for bottles; a small writing bench in one of the windows, with a shelf at the side for books; and a cupboard for storing apparatus when not in use.

In addition to the above, a few contrivances are required for use in the factory which also call for the carpenter's assistance.

5. *Megass Cages.*—These are deep rectangular boxes measuring 12 in. × 8 in. × 36 in. deep, and are constructed of No. 7 iron wire gauze (mentioned in the list below). To make one cage, cut off a piece of gauze, 3 ft. × 3 ft. 4 in., and fold it at a distance of 8 in. from one of the 3 ft. sides. Make another fold, in the same direction, at a distance of 12 in. from the first, and a third fold at a distance of 8 in. from the second. Open out these folds until they form right-angular bends, and lace the two free ends together to form the fourth angle. You thus have a rectangular "tube," 36 in. long which only requires a lid and a bottom to be converted into a box or cage. The ends of the "tube" must first by stiffened by inserting rectangular hoops of stout iron wire or of thin iron rod, the sides of the hoop measuring exactly 12 in. × 8 in. These are then securely laced to the gauze with lacing wire (mentioned in the list).

The lid and bottom of the cage are made from two pieces of gauze measuring $14\frac{1}{4}$ in. × $10\frac{1}{4}$ in. These measurements allow for 1 in. to be turned up all round, leaving a central area of $12\frac{1}{4}$ in. × $8\frac{1}{4}$ in. The method of folding these pieces after splitting the corners will be sufficiently obvious. One piece is then laced to one end of the gauze "tube" to form the bottom of the cage, whilst the other piece serves as a detachable lid. To enable the cage to be suspended from the hook of the spring balance, a loop of strong wire is secured to the uppermost iron hoop, this loop folding inwards when the lid is put on. (The cage is therefore weighed without the lid.)

Four such cages are required and it is convenient to make them of uniform weight by proceeding as follows: By suspending the cages from the hook of the spring balance, ascertain which is the heaviest and attach to this cage a small piece of sheet lead, which may be stamped "No. 1." Note the exact weight and then load each of the lighter cages with larger pieces of lead until these correspond in weight with No. 1. The lead tabs may then be marked No. 2, 3, and 4. The empty cage, without lid, will weigh about 3 lbs. and will hold 10 lbs. of loose megass. When filled the cages are heated

in a current of hot air, and we have next to describe a simple form of

6. *Drying Chamber.*—As a moderate temperature is sufficient, the heat radiated by the brickwork of one of the furnaces may be utilised as follows: Construct a strong wooden box without lid 6 ft. × 3 ft. 6 in. × 2ft. 6in. deep, but omitting one of the smaller sides (*i.e.*, 3 ft. 6 in. × 2 ft. 6 in.). Place this box on end against the furnace wall so that the open side is uppermost, and you have the drying chamber shown in *Fig. 2*.

A large hole cut near the base of each side admits cold air, which is rapidly heated by contact with the brick work and finally escapes at the top of the chamber. An upward current of air is thus produced, which attains its maximum temperature near the top of the chamber where two cages of megass are placed. The latter are supported horizontally on a shelf made of four parallel bars (two under each cage) as shown on a larger scale in *Fig. 3*, which represents a side-view of the upper part of the chamber; the furnace-wall being shown in section. These bars are of flat iron rod (about 4 ft. long, 1 in. wide, ⅜ in. thick) and are supported in holes cut in the side of the chamber in the positions indicated in *Fig. 3*. The cages are indicated in section by dotted lines, and are placed in the position shown, and not centrally, because the megass near the wall is liable to be charred by local over-heating.

The open top of the chamber affords easy access to the shelf when placing the cages in position or removing them after drying. The box must be constructed of boards which have been previously exposed to heat, warping of the joints being further minimised by banding with iron straps. It should rest on a level flooring, and be firmly secured in position against the furnace wall by means of a buttress.

The main difficulty is to find such a position for the drying chamber, that the heat will be sufficient without being excessive (a point to be referred to later). The temporary structure described and illustrated above, possesses the advantage that it can be moved from place to place (*i.e.*, nearer to, or further from, the hottest part of the wall). When a suitable position has been found, a permanent brick chamber can be built at a trifling cost.

7. *Masse-cuite Boxes.*—These are strong wooden boxes, with screwed joints; the three internal dimensions being alike 12 in., each box has a capacity of one cubic foot. This load of masse-cuite being more than one man can carry, two horizontal crosspieces are bolted to opposite sides of each box, the projecting ends being rounded so as to form two pairs of handles. Three such boxes are required to charge a 30 in. centrifugal in the test to be described later.

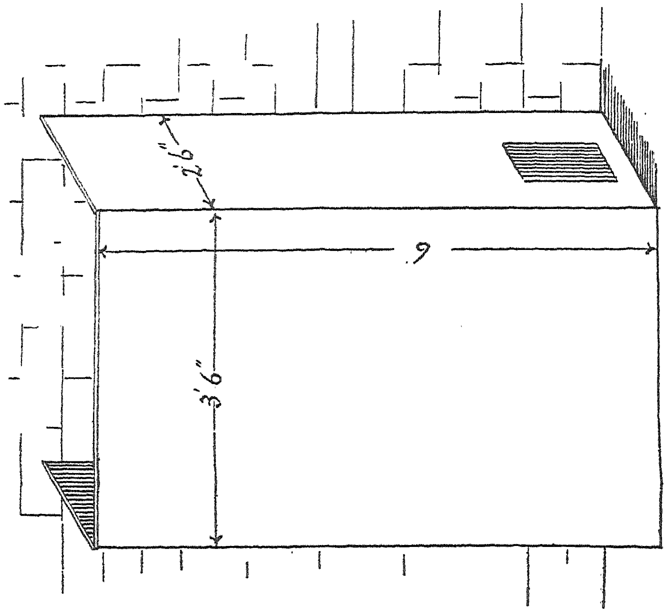

Fig. 2.

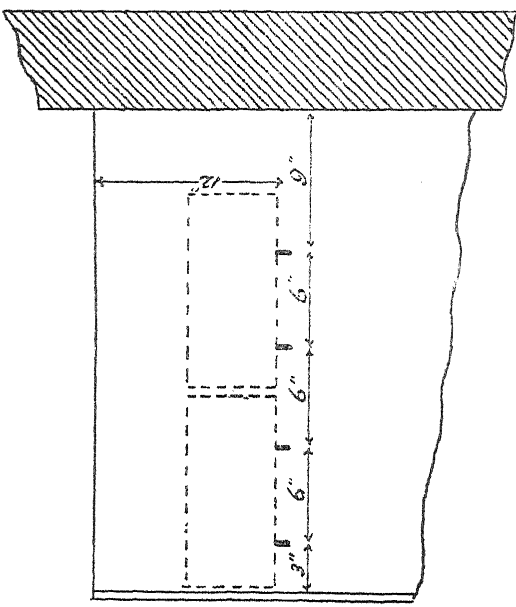

Fig. 3.

We have been obliged to occupy this chapter with uninteresting details, and here conclude with a list of apparatus and chemicals required in the course of our studies. List A. includes three items which are only required for testing coal, so that List B. can be substituted in factories where a coal-account is not a serious item in the working expenses. The two outfits can be obtained from Messrs. Townson & Mercer, 34, Camomile Street, London, E.C., who will also supply any item at the prices mentioned.

LIST A.

		£	s.	d.
(1.)	One polariscope, half-shadow, single compensation, for 200 m.m. with 100 and 200 m.m. tubes, complete in box	21	10	0
	One extra metal tube, 200 m.m., old pattern	1	0	0
	One dozen cover plates, for above	0	3	6
	Two dozen rubber washers, for above	0	1	2
	One polariscope lamp, adjustable, metal chimney, &c., for petroleum	1	3	6
	Ten yards wick for above	0	1	8
	Two spare lenses and two spare reflectors, for above.	0	5	0
	Nine flasks, graduated in Mohr's Units, at 17½ C., three each of:—			
	50 to 55 c.c.	0	4	0
	100 to 110 c.c.	0	4	10
	200 to 220 c.c.	0	7	4
(2.)	Six Balling hydrometers, graduated at 85° F. from 12° to 20° Balling in tenths of 1°, each tenth being about one-sixteenth of an inch, flat stem, total length of stem about 5 in., of bulb 4 in., diameter of bulb from ¾ in. to 1 in.	2	14	0
(3.)	One spring balance, No. 60, to weigh 20 lbs. by half-ounces, with hook attachment only, and two 12 in. brackets	1	2	6
(4.)	20 ft. woven iron wire, No. 7, 3 ft., wide	1	0	0
	3 lbs. lacing wire, 22 gauge	0	1	0
	2 ft. woven brass wire, 100 meshes to lineal inch, 2 ft. wide = 4 square feet	0	14	0
	One Beckers balance, in case, agate knives and planes, to carry 100 grams in each pan, sensitive to 1 m.g., without rider apparatus	3	2	6
	One set of weights, 100 grams to 1 m.g., with forceps in box with lid	0	12	6
	One German silver basin, with lip, and counterpoise weight	0	4	6
	Two spatulas, bone, 8 in. long	0	1	6
	Three hydrometer jars, with lip, 10 in. × 1⅜ in.	0	2	0
	Six " " " 6 in. × 1¼ in.	0	2	6

	£	s.	d.
Six funnels, plain, ground edges, 4 in. diameter	0	1	9
Three ,, ,, ,, 7½ in. ,, ...	0	4	6
Twelve ground glass covers, 5 in. diameter..	0	0	6
Six ,, ,, 8 in. ,, ...	0	1	6
One filter stand, black wood, for two 7½ in. funnels	0	4	2
Three graduated cylinders, on foot, with lip, 10 c.c. in tenths c.c.	0	2	0
Three pipettes, 10 c.c. graduated in tenths c.c.	0	2	6
Twelve packets of 100 circular filter papers, Muncktell's No. 1 F., 15 c.m. (6 in.) diameter	0	15	0
Six bottles, W.M. green glass, stoppered, one pint capacity	0	3	3
,, ,, N.M. white glass, flat stoppers, 6 oz. ,,	0	1	9
One gross test tubes, 4 in. × ⅝ in.	0	3	0
Six test tube brushes	0	0	6
One ,, holder	0	0	6
Two dozen books of neutral litmus paper	0	3	6
One yard black rubber tubing, ½ in. internal diameter ..	0	3	6
Two thermometers, 240 F. enclosed paper scale, cylindrical bulb	0	2	6
One calorimeter, Thompson's, for testing coal, complete in box	5	10	0
One spare glass cylinder, for above	0	7	6
One spare thermometer, ,, ...	0	12	6
One spirit lamp, glass, 8 oz. capacity	0	0	10
One mortar and pestle, wedgewood, 5 in. diameter	0	2	3
Two Winchester quarts basic acetate of lead	1	2	8
1 oz. mercuric bichloride	0	0	6
1 lb. sugar, chemically pure (Tates cubes)	0	0	6
Packed in case for export	£46	0	0

Note 1. From Franz Schmidt & Haensch, Berlin.
Note 2. From Kappeller, Vienna.
Note 3. From Messrs. Salter.
Note 4. From Messrs. Bryan, Corcoran, Ltd., 31, Mark Lane, E.C.

LIST B.

Same as List A. but omitting Thompson's calorimeter and spares. Packed in case for export £40 0 0

(To be continued.)

A Paris speculator in sugar is reported to have lost £600,000 in a single day.

THE NAUDET PROCESS.

By Robert Harvey, M.I.Mech.E.

(Of Harvey Engineering Company, Limited, Glasgow.)

(Continued from page 330.)

Description of the Apparatus.

The following description of the apparatus is intended to be read in conjunction with the accompanying diagram. The necessary apparatus includes:—

1st. The battery or series of cells may be either circular or in parallel lines, and consist of not less than eight vessels or cells of a known capacity, proportioned according to the work to be done.

2nd. A juice tank with two compartments (V^1, V^2), so that one part can be filling when the other is discharging. This tank receives the normal cold juice from the mill.

3rd. A mixing tank (M), wherein the necessary quantity of lime is added, and which also serves as a compensator. This tank is in communication with the discharge side of the circulating pump, and receives the hot juice after passing through the heaters, thus preparing the juice required for the next diffuser. It is also from this tank that the quantity of juice is drawn off to completely fill the diffuser after the first portion of cold normal juice has been admitted from the normal juice tank (V^1 or V^2), which is called the measuring tank.

4th. A circulating pump (P) of special construction, which draws the juice from the bottom of the mixing tank (M) through strainers and delivers or forces the juice on the delivery side through specially designed juice heaters, thence discharges into liming or mixing tank (M), and at same time on to the top of the diffuser in connection at the moment the juice of this diffuser goes in the mixing tank. This is repeated until the desired heat is obtained. By this rapid circulating of the hot limed juice through the well-opened or crushed megass the juice is thoroughly well filtered, the megass absorbing all the impurities.

5th. Two or more specially designed juice heaters (O) according to the size of the battery, wrought by exhaust steam or steam from the triple effet; these are fitted on the discharge side of the circulating pump for the purpose of heating the juice to the required temperature.

6th. Two strainers (R), one being cleaned while the other is in use, and placed on the suction side of circulating pump between bottom of diffuser and the pump. These strainers intercept and receive any small pieces of megass or cush-cush which may be in the juice coming from the bottom of diffuser.

7th. A water tank (S), 25 to 35 feet higher than the diffusion battery, which gives the required water pressure to the battery, the level of this water being maintained by a water pump.

8th. One or two measuring tanks (N) to receive the clear-finished juice drawn off from the battery; and hence, if for dark crystals, the juice goes direct to the triple effet or evaporator.

9th. An air-compressing apparatus (U), with its receiver, for supplying compressed air to clear the diffusers of juice and water before they are discharged of their exhausted megass.

10th. Valves and pipes of different kinds necessary for the battery, as follows:—

(A.) Valves which allow a portion of the juice to go to the mixing or liming tank during the forced circulation of the diffuser.

(B.) Pressure or forcing valves allowing the hot juice driven by the pump P, and passing through heaters O to return to the diffuser.

(F.) Valves making the communication of a diffuser with the one which directly precedes it by means of the communication pipes B.

(G.) Valves admitting the clear juice to the measuring tank N, and the mixing or liming tank M, bringing to this one the last of the drawn off juice needful for the mixing or filling up of the following diffuser.

(J.) Valves allowing the juice of tanks V^1 and V^2 to enter the diffuser.

(E.) Valves for supplying water to the battery coming from tank S.

5, 6, 7, 8. Valves for supplying compressed air from air receiver U before opening the large bottom megass discharge doors of the diffuser.

(K.) Valves for filling and discharging the juice tanks V^1 and V^2.

(H.) Valves for drawing off from the measuring tanks N and the mixing or liming tank M.

(I.) Valves for admitting the hot juice from the circulating pump to mixing tank M.

(X.) Sluice valve for regulating the drawing off during a given time and thus enabling the chief of the battery to regulate the speed of the battery in a way completely independent of the men employed in its working.

Method of Working the Process.

The diagram annexed shows plan and elevation, but only four diffusers are shown—eight would only be a needless extension of diagram—we will, therefore, suppose there are diffusers Nos. 1 to 8.

To extract the sugar contained in the megass, and to begin with: First fill diffuser No. 1 with megass and admit the water by valve E1. This diffuser being full, the heater and pipes are also full. The circulating pump being set in motion, open valves A1 and B1; the pump then (the heaters also being in operation) forces the hot water in diffuser No. 1 through B1; this water goes through the diffuser and returns by B1 and A1 to the tank M, whence the pump again

draws it up and drives it anew, as before, this giving the forced circulation.

After a few minutes the diffuser No. 1 and its contents reach a temperature of 200° to 220° Fahrenheit.

The water extracts the sugar contained in the megass until they are in equilibrium,—that is to say, until the water and megass contain the same quantity of sugar for the same weight.

When this point is reached No. 2 is full of megass, and valve A2 is opened, thus admitting the thin juice from the liming or mixing tank (M), then the valve B2 is opened and the same forced circulation and heating process is produced on diffuser No. 2 as was formerly done on No. 1. But as the liquid which bathes the fresh megass is no longer water but thin juice, when the equilibrium takes place the denser juice is the result.

During the heating and exhaustion of the megass in No. 2 the following takes place in No. 1 : The valves A1 and B1 are closed and valves G1 and E1 as well as the valve H of tank M are opened. The extra height of the water in tank S gives a pressure which drives a certain quantity of juice into the mixing or liming tank M, which, when full, will serve to complete the filling or saturation of diffuser No. 3.

The operation continues on No. 3 as on No 2, but with denser juice, and during that time the juice in No. 2 is driven by the water of No. 1 which passes by F1 and F2, comes out by G2, and goes to fill the mixing tank M.

The operation is repeated on Nos. 4, 5 and 6. At the same time No. 6 being in circulation, the valves B6 and A6 are open, as well as G5, F5, F4, F3, F2, and E1, all the others being shut.

The effect of these different operations is that the juice has become richer and richer through its contact with the fresh megass, and, of course, the richest juice is in No. 6. No. 5 contains juice of about one half as rich in density as No. 6 ; No. 4 about one half as rich as No. 5 ; No. 3 half as rich as No. 4 ; No. 2 half as rich as No. 3 ; and No. 1 contains little more than water.

Assuming that tank V1 is full of normal juice from the mill, the diffuser No. 7 is full of fresh megass; then valve J7 is opened and the juice contained in V1 flows in by gravity and fills about one half of the diffuser No. 7. When the tank V1 is empty, valve J7 is closed and valve A7 opened, thereby admitting the hot limed juice from the mixing tank M to completely fill the diffuser No. 7. By opening valve B7 the circulation is established by the circulating pump from the bottom to the top of diffuser No. 7, the pump drawing through the straining boxes and delivering through the juice heaters. At the same time the valve G6 is partially open, allowing a certain amount of this hot circulating juice to enter the mixing tank M until it is full, and so ready to complete the filling of the next diffuser No. 8.

During the circulation of the juice in No. 7, as above described, the juice is rapidly raised in temperature to about 200° F. or 220° F., and at same time purified by passing through the megass. When the tank M is full, the necessary quantity of lime is added to complete the clarification. This juice, mixed by the continual arrival of new juice from the circulating pump and heaters, returns to the top of the diffuser, and, passing down through the megass, is thus purified, leaving the precipitate in the megass of the diffuser, which has served as an excellent filter.

The diffuser No. 7 having circulated, No. 8 is full of megass, tank V2 being now full of juice; open valve J8, then when tank V2 is empty shut valve J8 and open valve A8.

When diffuser No. 8 is full of megass and juice, then valve B8 is opened and the circulation is thus set in motion. Then valves A7 and B7 are shut, valve G7 opened, and valve G6 shut and F7 opened.

While No. 8 is circulating, the hot rich juice contained in diffuser No. 7 is forced by the water pressure, on opening valve E2 on diffuser No. 2, into the tank N, the valves F3, F4, F5, F6, and F7 having been left open to establish communication between the diffusers.

When tank N contains the quantity desired to be drawn off from the diffuser—which is about 85 or 90 litres (= 18 to 20 gallons) for every 100 kilogrammes (= 220 lbs.) of the sugar cane ground at the mill—the entrance valve H on tank N is closed, and valve H on tank M is opened, thus allowing the remainder of the juice in the diffuser to be discharged into tank M previous to the filling up or saturation of the next diffuser.

During this time water or air having been applied to diffuser No. 2, diffuser No. 1 is isolated from the battery and discharged by opening the large door on the bottom of the diffuser. The exhausted megass, falling on to a carrier, is conveyed to a second mill where the water is extracted; the result is that the megass is then in a good condition to burn and is conveyed from the second mill to the megass furnaces of the steam boilers.

The filtered juice drawn off from each diffuser is there divided into two portions, the first portion going to the measuring tanks (N), and from there to the evaporator, the second portion going to the mixing or liming tank (M), to be used for the saturation of the next diffuser.

The quantity of water used in the diffusion, and which comes from the high-level water tank (S), may be partly reduced by the compressed air, by simply shutting the water valve of the last diffuser and opening the corresponding compressed air valve.

The first part of the drawing off may thus be by water and the second by compressed air, or *vice versa*, according to the time in which it is desired to discharge the exhausted diffuser.

On the plan shown there is a branch which leads the juice from the circulation pump direct into tank M through the valve I.

This branch allows the regulation of ~~the quantity~~ of juice going into the diffuser, also the quantity of juice going into the tank M where the hot juice is mixed and limed. The drawing-off pipes coming from valve G and connecting to tanks N and M, have a special regulating sluice valve, the use of which is to regulate in a given time the quantity of liquid to be drawn off, length of time being exactly equal to the duration of time occupied by one diffuser.

There is thus a certainty of extracting the same quantity of liquid from each diffuser. The level of the liquid in the tanks is shown by floats working on a graduated scale.

The speed of the battery can be automatically fixed by the chief of the factory entirely independently of the workmen in charge of the battery.

Thus the juice from the mill, whether sulphured or not, goes into the diffuser which has been filled with fresh megass, and comes out the first time filtered; it then undergoes the action of the purifying agent (say lime) and heat, and comes at last to be filtered a second time in the diffuser. It is then this dense juice—the hot and filtered juice remaining in the diffuser and in contact with the rich megass, which is driven by water or compressed air from the diffuser, the first part into the measuring tank and the second part into the mixing or saturation.

This description may look as if the process were complicated. It will not, however, be so to any one conversant with the ordinary process of diffusion. The process described is in fact diffusion with the addition of the Naudet Patent Diffuser for the forced circulation and diffusion of the megass at a high temperature.

The Advantages of the Process.

The process of diffusion by forced circulation and methodical washing of the megass offers the following advantages:—

1st. *Large extraction.*—Nearly the total amount of juice in the cane is extracted—that is, of the total juice in the cane 95% is extracted, and that with the low dilution of about 9% of water. When the megass is good and well opened up—and a dilution of 12% of water used—an extraction of 97% of the total juice in the cane is the result.

2nd. *Economy of fuel.*—With good steam boilers and well arranged megass furnaces, combined with proper arrangements in the use of the steam in the factory, little or no fuel is required beyond the exhausted megass from the diffusers.

3rd. *Complete purification.*—The complete purification of the juice without the use of clarifiers, subsiders, eliminators or filter presses. The juice goes direct to the evaporator or triple effet from the battery for dark sugars, and once through mechanical filters for Demerara or yellow crystals.

4th. *Economical production of white sugars.*—By the use of continuous sulphuration and proper liming of the juice, also passing the juice

and the syrup through Philippe or similar filters, a very fair white sugar can be produced at very little extra cost beyond dark sugar.

5th. *Small loss and complete recovery.*—As the juice is completely sterilised within about ten minutes after it is expressed from the cane by a high temperature and liming, also thereafter completely enclosed from the atmosphere, there is no loss from inversion, and thereby an increased recovery of sugar is obtained.

6th. *Small pressure.*—The risk of breakdown to the mills is reduced, as no such excessive pressure is required as is necessary in double or triple crushing, as only about 60% of the juice is extracted by the mill when single crushing which does not require much pressure and gives almost a pure juice. The remaining 40% of the juice is extracted by the battery—also as pure juice—and thus the impurities resulting from double, triple, and quadruple crushing are avoided, and so less impurities require to be eliminated by this process.

7th. *Simplicity.*—The whole process of sugar manufacture is much simplified; the expense and labour of washing out the clarifiers and eliminators, and the danger of this being neglected or improperly done, are avoided. Also, the expense and labour caused by the use of filter presses, and the wear and tear entailed by the cleaning of cloths, are done away with; indeed, the whole operation in the sugar factory is cleaner and more regular.

8th. *High purity.*—Another important point is that the juice from the diffuser has as high a purity as the juice from the mill. This process has a great advantage where the canes are hard and dry, as is the Yuba or White Transparent cane, and in a season which is unusually dry the advantage in the sugar recovered is very great as compared with double or triple crushing mills.

Results of the Process.

The first installation was made on the sugar estate of Messrs. Hinton & Sons, Madeira, where the process has now been at work for the last three years, effecting a great saving in fuel. Last year the average extraction for the whole crop was 95% of the juice in the cane. A very good white sugar was produced direct from the cane, which was used for local consumption and also for the manufacture of Madeira wine—showing the sugar to be of a high quality.

As already stated, the result at "Carona" Estate, Trinidad, was short of expectations owing to the defects in the first milling, the cane not being opened up sufficiently to give good diffusion results. As it was, however, it was a gain over double crushing.

At "Fortuna" Estate, Porto Rico, the extraction was good, the megass being in good condition, thanks to a crusher in front of the mill to open up the cane. The extraction was 96% of the total juice in the cane with a dilution of 9% on the weight of the cane, and the density of the juice from the diffusion battery was only 0·7°B. less than the

juice from the mill. This juice was also of equal purity to the juice from the mill.

As to the gain in sugar to be obtained by the Naudet Process, as compared with the present method of double or triple crushing, the following figures will speak for themselves:—

On one estate in Cuba last year, with a strong Krajewski Crusher in front of the first mill, and double crushing by powerful 3-roller mills, making a crop of 15,000 tons of sugar, the result was as under:—

Sugar in the cane		15·20
Loss in the megass	2·85	Loss 4·189
Loss in scums and filter presses ..	2·85	
Loss in molasses	0·779	
Undetermined losses	0·45	
Sugar obtained	11·007	
	15·196	

Total loss as above—4·189, less loss by the Naudet Process; the loss estimated on the above canes would be as under:—

Loss in megass	0·500
Loss in molasses	0·779
Undetermined losses	0·45
	1·729

4·189 less 1·729 equals a gain by the Naudet Process of 2·460; the sugar obtained would therefore be 11·007 + 2·460 = 13·467. This increased extraction of sugar worked out on the same amount of canes will give, not 15,000 tons but 18,300—a gain of 3,300, the money gain on which will depend upon the price of sugar. Say it is £11 per ton, then allow £1 per ton for the manufacture of the juice into sugar, which will leave an extra net profit of 3,300 × 10 = £33,000.

The claims of the Naudet Patent are very simple, and are as follows: "The application of forced circulation to every succeeding cell of a series of cells of a diffusion or macerating battery is accomplished by the use of a pump, the suction side of which communicates with the bottom of the cell, having straining boxes intervening to collect small pieces of cush-cush or megass that may be retained in the juice, the delivery side of the pump connected to the top of diffusion vessel having heaters intervening between the pump and the diffusion vessel to bring the juice to the required temperature."

There is now being erected at the Central "San Jose" in Cuba, belonging to Messrs. Rabel & Co., a large Naudet Plant which is to treat 1,800 tons of cane per day, and this plant will be in full work by the end of the year.

REVIEW OF THE INSECT PESTS AFFECTING THE SUGAR CANE.*

By H. A. BALLOU, B.Sc.,
Entomologist on the staff of the Imperial Department of Agriculture.

(Continued from page 343.)

THE CANE FLY.
(*Delphax saccharivora.*)

This small insect, although at one time believed to be a very severe pest, is not now considered as such, though generally present in small numbers each year. It appears to be well controlled by the lady-bird beetles (*Coccinellidae*) and the lace wing (*Chrysopa* sp.) except for occasional outbreaks on small areas. The presence of *Delphax* is generally indicated by black blight.

SCALE INSECTS.

Three species of scale insects are known to attack canes in the West Indies, viz., *Dactylopius sacchari*, *Dactylopius calceolariae*, and *Aspidiotus sacchari*.

These species of *Dactylopius* are 'mealy bugs,' soft-bodied insects covered with mealy wax. They attack the stems and are protected by the leaf-sheaths. *Aspidiotus sacchari* is a small, rounded, straw-coloured scale insect. These insects do but little harm, probably, and in the time ordinarily required for the growth of the crop would not become very numerous. No treatment is practicable except the exercise of great care not to plant infested canes.

THE SHOT BORER.
(*Xyleborus perforans.*)

This is a small, brownish beetle about $\frac{1}{10}$ inch in length. The greatest injury to canes from the boring of this insect is that the holes in the hard rind of the cane furnish an easy entrance for fungoid diseases such as the rind disease. As the species of *Xyleborus* readily attack dead and dying plants, and multiply in them rapidly, the prompt destruction of dead and dying canes will have the effect of reducing the number of shot borers, and checking its development and spread. The shot borer has not been prevalent in the West Indies for the past two years.

THE LARGER MOTH BORER.
(*Castnia licus*, Drury.)

This insect was first reporfed to the Imperial Department of Agriculture in October, 1904, from plantation Enmore, British Guiana, where it was then causing serious injury to the canes.

* Read at the Agricultural Conference at Trinidad last January.

Mr. Bethune, manager at Enmore, sent specimens of the larval and adult forms of the insect as well as pieces of cane and a stool of cane stumps showing the damage done, accompanied by statements as to its destructiveness. The Executive Secretary of the British Guiana Board of Agriculture forwarded a report by Mr. Ward, Agricultural Instructor, and further specimens accompanied this report.

From such correspondence and reports, and the specimens and material received, this paper has been prepared, the writer having had no opportunity of studying the insect in the field.

The egg is about 4 mm. ($\frac{1}{6}$ inch) in length and 1 mm. ($\frac{1}{25}$ inch) in width, spindle shaped, tapering to a point at either end, with five prominent longitudinal ribs from end to end. The colour ranges from a light-gray (nearly white) to a dark-gray. Eggs laid in captivity hatch in three or four days. Eggs have not been found in the field, and it is not known where they are laid. In captivity the eggs are laid singly and unattached.

The newly hatched larva (in captivity) is large in comparison with the size of the egg. Full-grown larvae are about $2\frac{1}{2}$ inches long and $\frac{1}{2}$ inch in diameter. The head is large, reddish-brown in colour, with large powerful mandibles, with which it eats its way through the canes. The mandibles are shiny-black. The segments of the thorax are the largest, thus giving the body its greatest size just behind the head. The abdominal segments are nearly uniform in size decreasing gradually posteriorly, the last one being the smallest.

The thoracic legs are small, brownish, situated on the large fleshy swellings of the three segments of the thorax. The abdominal legs are soft protuberances on the third, fourth, fifth, sixth, and last abdominal segments. All the body segments are swollen and prominent. The colour of the larva is whitish; the spiracles are very prominent, being large, and brown in colour. There are a few pale hairs most plainly seen on the head, on the last abdominal segment, and on each segment below the line of the spiracles. The skin is shiny, and slightly transparent.

On the dorsal surface of each of the second and third thoracic and the first seven abdominal segments, there is a small area set with short, brown spines or callosities, which serve to assist the larva in travelling along the tunnel in the cane.

The pupa is formed either in the canes at the base of the stool, or in the ground near the canes. The pupa is brown in colour, about $1\frac{1}{2}$ inches in length. The wing pads, antennae, and proboscis are very plainly visible. On the dorsal area of each of the abdominal segments, except the last, are spines and thickened processes. On the first six segments there are two rows, and on the seventh and eighth there is one row across the segment. These spines are short, sharp, and directed backward, and assist the pupa in wriggling its

way either through the tunnel in the cave toward the top of the stump, or through the ground, toward the surface, when the adult or imago is about to emerge. The pupa is sometimes enclosed in a rough cocoon, formed of the fibres of the cane, and sometimes in an earthern cell. (I have not seen a cocoon, and only one pupa—that one an imperfect one.)

The imago has a spread of wings of 3 to $3\frac{1}{4}$ inches. The body is $1\frac{1}{4}$ to $1\frac{3}{8}$ inches long. The colour is dark, brownish-gray, lighter beneath.

The fore wing is crossed on the upper surface by a broad white band just within the middle: outside this and nearly parallel with it a short white band extends from the front margin about half-way across. These white bands are seen on the under side of the fore wing also. Along the outer margin is a row of small, light spots, which are not conspicuous.

The hind wing has a white band on the upper surface running across it near the middle. This is interrupted, near the front margin, making two distinct spots, behind which the band gradually increases in width until near the hind margin, where it is at its widest. A corresponding white band is seen on the under surface of the hind wing, but it is narrower, and the two spots near its beginning are less distinctly separated. Along the outer margin of the hind wing above are six spots of pale orange, the first three smaller and less distinct than the last three.

The head is large, with large, prominent eyes of a dark, velvety-brown colour. The antennae are slender, swollen towards the end, tipped with a small, slightly curved point, dark-brown in colour, lighter at the tip. The proboscis is slender, light-brown in colour, about $\frac{1}{2}$ inch in length, coiled under the head when not extended for feeding, &c.

The body is robust, clothed with coarse scales which are long and hair-like at the anal end. Colour, similar to the wings, dark-brown above, paler below.

Habits.—The eggs are laid (in captivity) singly and not attached. It is not known where they are deposited in the field, but it is suggested that they may be laid in the axils of the leaves, or in the ground at the base of the plant.

The larva enters the cane at the base of the plant and tunnels upwards about two feet, and then turns and goes back through the same tunnel and bores its way into the underground part of the plant. Canes have been found in which the larvae evidently entered high up on the plant and worked their way downward, but such exceptions are rare.

It is not known how long a time is required for the growth of the larva from the hatching of the egg to the forming of the pupa. Only one larva has been found in a cane, and it is likely that one larva

attacks more than one cane, perhaps all the canes in a stool, as in some cases the underground stems are all tunnelled through, so that all the tunnels in the stems of a stool are connected. In some cases, too, the underground stems are eaten through at the sides, so that the tunnels connect with the soil around the plant. It is not known whether the larva tunnels underground from one stool of canes to another, but it seems likely. Larvae in captivity in the laboratory of the Imperial Department of Agriculture tunnelled through and through the soil in a glass dish in which they were kept. The soil was six inches deep and the larvae went to the bottom of the dish, and the tunnels penetrated in all directions through the soil.

The duration of the pupal stage is not known, nor is it known whether the adult feeds at all after emerging from the pupa. The adult or imago is a day-flying moth, greatly resembling a butterfly in its general appearance.

The damage to the canes is of two kinds. The larva eats out a large amount of the sugar-containing portion of the cane, and so thoroughly tunnels the stumps and underground portions that it is impossible to get ratoons from them.

Occurrence.—The larger moth borer has been known at plantation Enmore for the past three years, but has not occurred in seriously large numbers until the present season (1904). The moths have been most abundant in January and February in previous years, and a few have been seen in May or June, following a mid-year cutting of canes.

As the specimens received from British Guiana appeared to be identical with some large caterpillars received some years ago from Marienburg estate in Surinam, a letter of inquiry was sent to Dr. C. J. van Hall, Director of Agriculture for the Dutch West Indies, asking for particulars as to the outbreak in Surinam. Dr. van Hall wrote that the description of the pest corresponded with a pest of canes known at Marienburg some five or six years previously. "The pest appeared suddenly and assumed a dangerous character, but very soon the borers disappeared, and so far as we know they have not been seen here any more." Early in 1903 a large lepidopterous insect was sent to the head office from Trinidad, which was said to be a borer in bananas. The specimen was very badly injured and was not identified, but it is believed to be the same as the one under discussion.

Remedies.—Several remedies have been suggested, but only two have been tried. These are (1) catching the adult, while flying, with nets, and (2) plugging the borer holes in the top of the cane stumps with clay to prevent the emergence of the adult. By the first of these methods large numbers of the moths were caught by coolie children at plantation Enmore. The second seems not to be very

efficient, as the clay crumbles in the sun and opportunity is thus provided for the escape of the moths. Carbon bisulphide is not available in British Guiana, or it might be possible to make use of this valuable insecticide. The moths have not been observed to feed on any flowers, nor will they feed on sweets provided them in captivity. If they were attracted to any food, use might be made of poisoned baits.

JAMAICA.

In a neatly printed booklet which has just been issued, containing a copy of the syllabus of a special course of study for distillers on the science of rum manufacture at the Government Laboratory, at Hope, Dr. Cousins, the island chemist, gives a most interesting little essay on rum distillation. He says, "The sugar industry in Jamaica has survived the severe trials of the past twenty-five years with the aid of two special advantages peculiar to the island: i. The splendid agricultural facilities for the cheap growth of canes; ii. The economy of rum as a means of recovering losses in the manufacture of sugar.

The efficiency of a Jamaica estate, where good rum is made on sound lines, will compare well with that of many an estate where more modern and elaborate processes of sugar manufacture obtain. This, of course, refers to the juice as delivered from the mill. It is impossible to ignore the fact that we are losing 20 to 25% of our produce on many estates through defective crushing.

In the ordinary process of rum manufacture 14 lbs. of sugar, as sent to the distillery, will yield 1 gallon of 40 p. rum. So long as the price of 8 gallons of rum (exclusive of puncheon) is not below that of 1 cwt. of sugar on the estate, inversion losses in manufacture are recovered in the distillery. Where high-class rums are produced, selling at 5s. to 8s. per gallon, muscovado sugar becomes quite a secondary consideration, and the quality of rum is the chief factor in the success of the estate's working.

When the writer first studied the conditions of the sugar industry in Jamaica he was struck with the unique position of rum as a factor in the success of sugar planters in the island, and with the entire absence of any exact or scientific data the distillers in Jamaica, by generations of experience, have been able to produce rum of such high quality as to command the premier position in the estimation of the world. Some of the high-class drinking rums are possessed of most attractive qualities to the senses of smell and taste. It would be presumptuous for any technical scientist to say that he could improve on the best rums produced in Jamaica, but it is clear as the noonday sun that we cannot maintain a high standard or improve a low one without exercising some control over the operations of

fermentation in the distilleries of Jamaica. To this end arrangements have been made for ten distillers to attend a three weeks' course of special study and experimental work each year at the central laboratory, so that these men may go back to their work armed with the means for controlling the operations of rum manufacture.

We are still at the very fringe of the subject, from a scientific point of view; and it is hoped that this actual contact between the scientific staff and the practical men concerned will enable a rapid extension of intelligent and critical control to be established in the distilleries of the island.

The plans for the establishment of sugar factories have now taken practical shape, and the machinery has been ordered.

ON THE DETERMINATION OF SUGAR AND FIBRE IN CANE AND MEGASS.

By H. and L. Pellet.

(Continued from page 331.)

On the Determination of Fibre in Cane and Megass by Digestion with Water and with Alcohol.

In ascertaining the weight of insoluble matters (crude fibre) in the cane it has long been customary to remove the soluble constituents by digestion with water. But alcohol has been used for the same purpose in Java for some years, in consequence of experiments connected with the direct estimation of sugar in the cane, in which the solvent action of alcohol was compared with that of water. It was then found that the water extract gave the same results as when alcohol was employed, and was also simpler and more rapid. But, as regards the weight of fibre yielded by these two methods, this was always higher when alcohol was employed, and consequently alcoholic extraction has since been recognised in Java as the "official" method for the determination of fibre in the cane.

In our own work we have continued to employ water for this purpose, in order that we might compare the percentage of fibre in the megass with that in the cane after extraction with water in the ordinary processes of manufacture. We are also of opinion that the use of alcohol for analysing the products of cane factories presents the same inconveniences as are met with in the beet sucreries. In the latter industry alcoholic extraction has been almost completely abandoned for estimating sugar in beets, because it invariably yields results which are too low. Moreover, in the case of Egyptian canes, we have found it difficult to extract the whole of the sugar by means of alcohol, whether the canes are sliced or otherwise finely divided.

We are even inclined to believe that the use of alcohol, in relatively large proportion to the weight of cane treated, may cause precipitation of organic and mineral substances in sufficient quantities to explain the increased weight of fibre obtained after alcoholic extraction over that resulting when water is the solvent, and that this occurs even when the extraction is incomplete. Alcohol precipitates simultaneously the silica, phosphates, and organic substances (both nitrogenous and non-nitrogenous).

To test this point we treated 100 c.c. of the first and second mill juices with 500 c.c. of alcohol of 95°. A slight turbidity was produced, which gradually descended as a precipitate to the bottom of the vessel. This proportion of alcohol is required to complete the precipitation, otherwise a part of the insoluble material remains suspended in the mixture. Collecting and weighing these deposits we found in 100 c.c. of juice:—

	First Mill Juice.	Second Mill Juice.
Weight of dry matter ..	0·280 ..	0·365

On the other hand, with an extraction not exceeding 67 litres per 100 litres of normal juice, an appreciable quantity of juice remains in the megass. But this juice is of much lower purity than that extracted, as is shown by many tests made in Hawaii:—

	Mill Juices. First Mill.	Second Mill.	Third Mill.
Purity	89·5 ..	83·6 ..	80·0

It is therefore reasonable to suppose that the residual juice would contain at least 0·08 to 0·10 more of such substances insoluble in alcohol, say, perhaps, 0·45 per 100 c.c. Therefore, in the total juice of the cane, as calculated from 100 − fibre, the matters precipitated by alcohol might amount to from 0·33 to 0·35 per 100 c.c. Assuming 10% of fibre, 90 parts of juice by weight, or 84 litres of juice by volume, we then have: $\frac{84 \times 0{\cdot}35}{100} = 0{\cdot}292$, say, 30 grams of material precipitated. In a word, when 20, 30, or 50 grams of finely divided cane are treated with a large volume of alcohol of 95°, from every 100 c.c. of juice, there are precipitated about 0·30 of organic and mineral matters. So that, in comparing the insoluble residues resulting from extraction with water and with alcohol, the latter yields results which are 0·30% higher than those yielded by water, and this plus error is reckoned as fibre.

We believe that, in practice, this difference may be even greater if to the substances precipitated be added a small proportion of sugar, which strong alcohol may easily fail to remove. It is therefore necessary to make sure that the extracted material contains no more sugar, which may frequently be present, even when the final alcoholic extracts do not appear to contain any. An error of 0·01 to 0·03% is quite possible from this cause, increasing the total error on the fibre to 0·5, or even to 0·7.

But assuming the complete extraction of the sugar by means of alcohol, the fact remains that the residual fibre will be too high to the extent of 0·30% or more, owing to the precipitation of organic and mineral substances contained in the juice. The same observations apply to the determination of fibre in the megass.

We recollect that similar experiments were carried out in connection with the determination of the marc in beetroots, and that in proportion as the strength of the alcohol was increased, so did the proportion of insoluble marc. But here again, other substances were precipitated and falsely weighed as marc, so that alcohol is no longer employed for this purpose.

We think we have thus demonstrated that the use of alcohol in the determination of fibre in cane and megass does not furnish accurate results, and that the use of this solvent should be abandoned in the cane factory as it has already been in the beet sucrerie.

Comparative Experiments in the Determination of Fibre in the Cane by Extraction with Water and with Alcohol.

1. By successive extractions under the best known conditions.

Fibre, insoluble in alcohol	9·80
,, ,, water	9·35
Difference	0·45

which supports our views as given above.

2. A series of ordinary tests gave—

	Alcohol.	Water.
A.	9·80	9·40
B.	9·70	9·40
C.	9·75	9·40
Means	9·75	9·40

These again prove an increase of 0·30% in the fibre when alcohol is used as the solvent.

3. Next we have a comparison made, when the sample of cane was less finely divided than usual, although crushed in an iron mortar:—

	Alcohol.	Water.
Fibre	12·0	10·15

This difference is very important, but indicates that the sugar has not been completely extracted by the alcohol. In fact, we find:—

Sugar	13·564	14·394

Or a difference of 0·83%, but this unextracted sugar is accompanied by other substances.

Calculation shows that in the incomplete extraction of the sugar by means of alcohol there remains first of all 1·05 of solid matter (sugar, &c.), then by the precipitation of other substances in the juice there is an additional 0·35, and, finally, in the last treatment

with alcohol, that portion of the liquid which penetrates the megass is always richer in sugar than that exterior to the megass, which quantity may amount to another 0·30. The total error on the fibre, when alcohol is the solvent, may therefore reach 1·70. And $10·15 + 1·70 = 11·85\%$. The difference between this and 12·0 (when water was used) is small, and indicates that the use of alcohol is perhaps the cause of excessive and very variable figures for fibre-content of the cane.

When every precaution is taken in the determination of the fibre the percentages of this constituent of the cane do not vary to any considerable extent from day to day, and we have noticed that during an entire manufacturing season these variations did not exceed the limits of 9·60 and 10·50. Percentages of 11% or more indicate that the canes have become partially dried during delays in transport, or, more frequently, that the sample tested does not truly represent the average. In fact, the sampling of the whole cane for the determination of the fibre is as difficult an operation as in the case of the direct determination of the sugar. The possibility of inaccurate sampling, when operating on the whole canes, is still more apparent when it is remembered that certain parts of the cane-stem contain 6 or 7% of fibre, while other parts contain 13, 15, and 17%. Whereas, in the analysis of fresh chips, the daily results are much less variable.

During the past year our analyses of Egyptian canes have yielded 9·50, 9·80, 10·00, 10·20, and 10·40 of fibre, giving an average which closely approximates to 10·0%, which forms the basis of all our calculations. We think that if this percentage be verified each year in the factories working by diffusion it may be adopted in factories working with mills with much less chance of error than when the fibre is estimated every day, for sometimes one may find 8·50, 9·50, 12·00, or 12·50 of fibre, when the true average is only 9·80, 10·0, or 10·20. We should, however, admit that in certain years the average fibre-content will be nearer 9·0 or 9·20 than 10·0, but the figure 10·0 represents the average for Egyptian canes as found after ten years' observation in several important usines. We may state that appreciable variations do occur, but so far our results have not been sufficiently numerous to be dealt with at length.

Quality of the Fibre.

As regards the physical quality of the cellular tissue of the cane we may state that the canes examined included those containing a variable proportion of crude fibre, and that this fibre similarly contained a variable proportion of cellulose.

If the average fibre-content varied but slightly from 10·0%, some canes contained 8·50, 8·75%, and others 11·0 and 12·0%. Moreover,

the percentage of cellulose in the crude fibre varied from 33·0 to 45·0%, so that certain canes contained 2·5% of cellulose, and others as much as 5·0%.

This difference in the percentage of cellulose indicates a considerable difference in the physical quality of the fibre, for when there is much cellulose the fibre is much more resistant. The physical quality of the fibre also differs with the variety of cane. Hence it follows that the extraction of juice varies considerably according as the cane fibre is soft, tough, or midway between these extremes, even when the canes are equally mature. Consequently the quality of the megass is also variable. According to the variety of cane the cellular tissue presents marked characteristics, one variety of cane giving a megass of a very fibrous structure, another giving a finely powdered megass, and another a megass of an intermediate character.

But with the same fibre-content and an equal proportion of cellulose per 100 of fibre, the canes may still show differences in milling characters according as the cellulose itself is of a hard or soft variety. A laboratory mill is sufficient to demonstrate all these variations. Naturally it is essential to operate always under the same conditions, but with a little practice one is soon able to study the milling qualities of the canes and also to recognise the quality of the megass. It is by such laboratory tests that one discovers canes which yield only 40 litres of juice per 100 kilos, others which yield from 50 to 55 litres, and others again yielding as much as 66 or 67 litres after three crushings.

Conclusions.

1. The fibre of the cane presents great differences in its resistance to pressure according to the conditions under which it has developed; the nature of the soil, whether irrigated or not, temperature, variety of cane, period of vegetation, richness, degree of maturity.

2. That, whereas some canes submitted to single crushing yield from 70 to 73 kilos of juice, other canes under the same conditions yield only from 55 to 56 kilos of juice.

3. The direct determination of sugar in the cane, when operating on the whole cane does not give the true average richness, owing to the variable composition of individual canes and of canes grown on different soils, &c.

4. That the richness of the cane can only be approximately deduced by the indirect method.

5. The direct determination of sugar in the cane can be effected with some approximation to accuracy in factories working by diffusion, the slicing of the cane affording the means of securing an average sample.

6. The determination of sugar, in the fresh chips or in the finely divided cane, can only be relied upon when a sufficiently large quantity of the material is treated, at least 50 grams being treated by successive extractions with boiling water, and the extraction being controlled by a final treatment of the residue.

7. The foregoing observations apply also to the determination of sugar in the megass.

8. Alcohol may also be employed for extracting the sugar, provided that the material is very finely divided, and that the extraction is always controlled by a final washing (or by a second extraction with alcohol if Soxhlet's apparatus is used). Yet we have shown that in certain cases the control extraction does not reveal any sugar, although this may be present in the material treated, because of the resistance of the cells to diffusion in the presence of alcohol. It is therefore necessary to treat the extracted material with water in order to make sure that the alcoholic extraction is complete.

9. Cold aqueous digestion does not always yield accurate results under the conditions in which samples of cane, cane-chips, or megass are generally prepared for analysis. The time required to reduce such samples to the requisite state of division renders the analysis impracticable, and there is also an appreciable amount of evaporation during such preparation.

10. For the determination of fibre in the cane the greatest care must be taken to secure an average sample, and the use of alcohol as a solvent must be abandoned. Alcohol precipitates from the juice a number of organic and mineral substances, which remain with the true fibre and thus augment its weight by about 0·30 to 0·40%. Moreover, sugar being much less soluble in alcohol than in water, it follows that unless great care is taken to ensure complete extraction, some sugar and other substances which are present with it in the juice remain to be weighed along with the fibre, and may thus increase the percentage of the latter by 0·5 or 1·0, or more. The use of alcohol ought therefore to be excluded from cane factories, as it has nearly been from beet sucreries.

11. For equal quantities of fibre by weight the canes do not offer the same resistance to milling, and do not contain the same proportion of cellulose. Our experiments on this subject are being continued.—*(Bulletin de l'Assoc. des Chimistes.)*

THE POLARIMETRIC DETERMINATION OF SUCROSE.

By The Hon. Francis Watts, C.M.G., D.Sc., F.I.C., F.C.S., and H. A. Tempany, B.Sc., A.I.C.

For several years a keen controversy has been waged concerning the influence of temperature upon the polarimetric determination of sucrose. Alteration of temperature affects the determination in several ways: by causing changes in the volumes of the measuring vessels and polarimeter tubes, by altering the optical activity of the quartz which forms an essential part of some forms of polarimeter, and possibly by affecting the optical activity of sucrose itself.

Concerning all these points, except the last, there is absolute agreement between all the workers in this field; the last has, however, given rise to very warm discussion. This has been reviewed by Dr. Wiechmann in a paper presented to the International Commission for Uniform Methods of Sugar Analysis* in which he reviews the work of different observers, whom he classifies in two lists, namely, (*a*) those who maintain that change of temperature has no perceptible effect on the optical activity of sucrose, and (*b*) those who maintain that the effect is perceptible, and measurable, and of sufficient magnitude to be taken into account in laboratories working at tropical temperatures.

The question is of considerable commercial importance owing to the fact that large quantities of sugar are produced and sold in countries having a tropical climate and are then transferred to, and refined in, countries possessing a temperate climate. Should temperature affect the optical activity of sucrose to such an extent as to alter it even by ·3 per cent. for a range of some 12° C., as some observers claim, then the seller in the tropics may be claiming payment on a basis which is in error by ·3 per cent. This may appear small in itself, but when applied to some 4,000,000 or 5,000,000 tons of cane sugar produced in the tropics it means a sum in dispute of £120,000 to £150,000 a year.

The subject has assumed great importance from the fact that the United States Government has decided that in determining the polariscopic test of sugar for customs purposes, the alleged change in the optical activity of sucrose with change of temperature shall be taken into account and a corresponding correction made, thus giving important official sanction to the views of one party. This has the effect of increasing the revenue by some $100,000 or more a year over the amount that would be levied, were the polariscopic test made in the tropical countries in which the sugar is grown, a sum sufficiently large to attract the attention both of revenue authorities and those dealing in sugar.

* Reprinted in the *International Sugar Journal*, Vol. II. (1900), p. 491 et seq.

In view of the statements contained in the interesting paper by Wiechmann, already referred to, we set ourselves to inquire into the question with a good deal of care. Pure sugar from Khalbaum was used in the work; this was carefully dried before use.

As a result we found that the standard weight of 26·048 grammes of sucrose dissolved in 100 *true* cubic centimeters of distilled water at 30° C. and read at a temperature of 29·3° C. gave a reading of 99·765, and in a second case when observed at 29·7° C. a reading of 99·79 on the Ventzke scale.* Introducing a correction of ·034 per degree C. for the slight contraction due to change of temperature during the polarimetric observations, these readings become 99·745 and 99·78 respectively. The readings are the means of a series taken by two observers: they are in close agreement and are within the limit of accuracy obtainable on our instrument (a triple-field Schmidt and Haensch "white light" polarimeter). This instrument was checked by means of quartz plates which had been carefully standardised, both at the Reichanstalt Charlottenburg, and by Dr. H. W. Wiley at Washington.

These readings, however, are not true percentages of sucrose in the sample of cane sugar. The following points require to be taken into consideration:—

(*a.*) The Ventzke scale is based upon the solution of 26·048 grammes of sugar in 100 Mohr cubic centimetres equal to 100·228 true cubic centimetres. Hence our readings must be corrected by multiplying by $\frac{100}{100{\cdot}228}$, as our solution was too concentrated for proper observation on the Ventzke scale.*

(*b.*) It is well known that the optical activity of quartz itself and therefore of the quartz wedge of the Schmidt & Haensch polarimeter is affected by temperature: this has been carefully studied by Jobin (*Zeitschrift des Vereins für Ruben Zucker Industrie*, 1898, p. 835) who finds that the correction to be applied to Schmidt & Haensch instruments may be expressed by the formula, Polarisation $+ ({\cdot}00016t)\,N$, where t is the difference of temperature of observation from that at which the instrument was standardised, and N is the scale reading.

In the case of our observations this correction is—

(*a.*) $\cdot 00016 \times 11{\cdot}8 \times 99{\cdot}745$ or ·188 degrees Ventzke.
(*b.*) $\cdot 00016 \times 12{\cdot}2 \times 99{\cdot}78$ or ·195 ,, ,,

Our readings in the two series of experiments thus become—

$$99{\cdot}745 + {\cdot}188 = 99{\cdot}933$$
$$\text{and } 99{\cdot}78 + {\cdot}195 = 99{\cdot}975$$

* The true cubic centimetre is taken as being the volume of one gramme of water weighed in vacuo at 4° C., while 100 c.c. Mohr are defined in this case as being 100 grammes of water at 17·5° C. in air, no correction being made for the effect of the displacement of air; under these conditions 100 c.c. Mohr become equal to 100·228 c.c. true; see Wiley, *Principles and Practice of Agricultural Analysis*, Vol. III., p. 99.

And when corrected for the relationship between Mohr and true cubic centimetres –

$$\frac{99 \cdot 933 \times 100}{100 \cdot 228} = 99 \cdot 705 \text{ and } \frac{99 \cdot 975 \times 100}{100 \cdot 822} = 99 \cdot 748.$$

In the first instance we therefore observe a difference of ·294 per cent., and in the second one of ·252 per cent. We believe that we are correct in attributing this difference to the effect of temperature upon the optical activity of sucrose. These results are in as close agreement with those of Wiley & Harrison as can be expected when the observations are made with a polarimeter.

From the above observations we conclude that changes of temperature (up to about 30° C.) cause a lowering of the reading on the Ventzke scale which may be corrected by the formula Polarisation $+ (\cdot 00023t)\ N$, where t is the difference of temperature of observation from that at which the instrument was standardized, and N is the scale reading observed.

For solution requiring no clarifying reagents we recommend the the following:—

The solution of 26 grammes of sugar in 100 *true* cubic centimetres. (This is equivalent to 26·048 in Mohr cubic centimetres.)

The correction quartz change by Jobin's formula, and the correction "Sucrose change" by the above formula, Polarization $+ (\cdot 00023t)\ N$, or combining the two, Polarization $+ (\cdot 00039t)\ N$.

Error due to the Volume of the Lead Precipitate.

The foregoing method will give correct' determinations when working with solutions requiring no clarification, but a serious error is introduced when the ordinary method of clarification is used—consisting in adding a solution of basic acetate of lead to the sugar solution and subsequently making up to 100 c.c.—due to the volume occupied by the lead precipitate, which results in the sugar being dissolved in less than 100 c.c. of solvent.

The question of the effect of the volume occupied by the lead precipitate has been treated by several writers, but does not appear to have received the general attention it demands. This lack of attention is probably due to the difficulty experienced in measuring it, and as it varies with each class of sugar dealt with, observers have found great difficulty in satisfying themselves of the appropriate correction to apply.

The method usually suggested for measuring this volume is that of Scheibler. In this method the sugar is dissolved in water, a measured quantity of solution of basic acetate of lead is added, the volume made up to 100 c.c., the solution filtered and the polarimetric determination made in the usual way. A second solution is made in a precisely similar manner except that the volume is made up to 200 c.c.: this is filtered and a polarimetric reading taken. The true

polarimetric reading of the sugar under examination is obtained by doubling the second reading and deducting this quantity from the first reading, the difference is multiplied by two and deducted from the first reading, the result is the corrected reading. From this the volume of the precipitate can be readily calculated. This has been discussed by Wiechmann in a paper read before the International Congress of Applied Chemistry at Berlin, June, 1903.* in which he points out several objections to it and suggests other methods.

The chief objection to our minds lies in the fact that the possible errors in reading the polarimeter are of greater magnitude than the quantity it is sought to measure, as the following will show :—

The volume of the lead precipitate, in the case of muscovados, can be taken as affecting the polarimeter readings to the extent of some ·2 to ·4 Ventzke scale divisions, while the accuracy with which a reading can be taken is about ·05 to ·1 Ventzke scale divisions.

If we take a case in which the respective readings in a double dilution experiment were 90·7 and 45·3 respectively the corrected reading would be 90·5; if, however, the original readings are assumed to be in error to the extent of ·05 divisions of the scale, and we calculate the corrected readings for all possible values we obtain "corrected" readings ranging from 90·25 to 90·7, a variation greater than the quantity to be measured. This method is therefore obviously inapplicable.

A second is that of Sachs. This is described by Wiechmann as follows: "A precipitate is produced by sub-acetate of lead. This precipitate is washed with cold water and with hot water till all the sugar is removed, and is then introduced into a 100 c.c. flask; a normal weight of pure sugar is added, and the solution is made up to 100 c.c. with distilled water. This solution is well mixed, filtered, and polarised, and the volume of the precipitate ascertained in the following manner :—

A = Percentage of purity of the sucrose in solution.

B = Polarisation of the solution when containing the precipitate.

V = Volume of the precipitate is equal to $\frac{100B - 100A}{B}$.

This method is unsatisfactory partly from the want of delicacy of the optical method where errors of ·05 to ·1 degree Ventzke may occur in each reading, and partly because it involves much handling of the precipitate.

All optical methods are open to the objection that the experimental errors are bound to be relatively large, and the results on small volumes of precipitates relatively inaccurate.

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* *International Sugar Journal*, Vol. V. 1903, p. 376.

Other methods therefore should be sought to effect this measurement. A densimetric method at once appears rational and obvious. Unfortunately, a method based on double dilution is not directly applicable to this problem, for the "excess gravity" of sucrose solutions is not a direct function of the concentration as shown by the classic researches of Gerlach and others, and any attempt to measure the volume of the precipitate by the effect of dilution on the specific gravity becomes extremely complicated. We have spent much time in an attempt to apply this principle to the problem but without success.

Wiechmann * adopted a process based upon cautious precipitation with sub-acetate of lead, filtering off the precipitate and washing it with hot and cold water, after which it was dried at 100° C. and weighed. The specific gravity of the precipitate was ascertained by weighing in benzene. Weichmann's method involves some inconveniences particularly in that it requires a good deal of manipulation of the precipitate. We have adopted a modification which reduces the work, and is, we believe, more satisfactory.

In our method the operations of preparing the solution, precipitating with lead acetate † and making up to 100 c.c. are performed in a tared specific gravity flask, the water content of which is accurately known. The flask with its contents is weighed, after which the solution is filtered off and its specific gravity accurately taken. The precipitate is washed with water till free from sugar, dried at 100° C. and weighed, a tared filter paper being used to reduce the manipulation required. From these data the volume of liquid displaced by the lead precipitate is readily calculated.‡

By using the solution from which the precipitate is thrown down as the medium in which its specific gravity is taken, we avoid a good deal of manipulation and at the same time we have a medium in which it is quite insoluble. The subsequent operations of washing, drying, and weighing give but little trouble.

Following this method, the precipitates produced in the clarification of several sugars have been examined with the following results :—

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* Loc. cit.

† 2 c.c. of a solution of basic lead acetate of Sp. Gr. 1·27.

‡ Weight of solution and precipitate contained in tared Sp. Gr. flask = 109·738 gms. (A).

Sp. Gr. of solution $\frac{30^\circ\ C.}{30^\circ\ C.}$ = 1·0976 (S).

Water content of flask at 30° C. = 99·723.

Whence solution content of flask at 30 C°. = 109,446 gms. (C).

Weight of precipitate = ·7240 gms. (B).

C − (A − B) = ·432 gms. = W.

$V = \frac{W}{S}$ = ·39 c.c. with sufficient approximation.

No.[1]	Weight of precipitate from normal weight of sugar. gms.	Volume of precipitate. c.c.	Sp. Gr. of precipitate.
1	·6506	·35	1·859
2	·6530	·33	1·945
3	·6609	·35	1·888
4	·7240	·39	1·856
5	·7389	·44	1·680
6	·7400	.42	1·760
7	·6786	·305	2·229
8	·6731	·45	1·495
9	·656	·42	1·560
10	·416	·25	1·640

[1] Nos. 1-8 are Muscovado Sugar. No. 9, Low-grade Crystals. No. 10, Yellow Crystals.

From these results, as well as from those of other observers, it is obvious that a very considerable error is introduced into the polarimetric determination of sucrose, if no account is taken of the volume occupied by the lead precipitate.

When working at tropical temperatures in the neighbourhood of 30° C., the error produced by the volume of the lead precipitate to a large extent compensates the errors introduced by the effect of temperature on optical activity of sucrose and on the quartz wedge of the Schmidt and Haensch polarimeter. Thus tropical observations in which no corrections are introduced are more in accord with theoretically accurate readings than those in which corrections are made for the effect of temperature on the optical activity of quartz and sucrose while neglecting the effect of the volume occupied by the lead precipitate.

In laboratories having a temperature near to that at which the polarimeters are standardized, and where no temperature corrections are necessary, the error introduced by the volume of the precipitate is serious.

A method of clarification has been proposed by A. D. Horne* by which, it is claimed, the error due to the volume of the lead precipitate is eliminated or reduced to a negligible quantity, while the method itself is as simple as those in ordinary use, and entails no extra work on the observer.

Horne's method consists in making up the sugar solution to the required 100 c.c. before adding the precipitating reagent, and using dry anhydrous basic lead acetate as the precipitant and clarifying reagent. This ensures that the sucrose is dissolved in 100 c.c. of solution and presumes that no change is introduced into the volume of the solution during the process of clarification. This appears to be the case provided that excess of the lead salt be avoided. The

* Read before the New York section of the American Chemical Society, December, 1903.

volume of the radicle entering into solution appears to compensate very closely the volume of the complex radicles removed by precipitation. To ensure accurate results, therefore, it is necessary to avoid the use of an excess of lead salt, for if excess be used the volume of the solvent liquid is increased and error creeps in.

We have examined this method critically in the case of several samples of sugar, by determining the polarization when the solutions were clarified with basic lead acetate before making up to volume, then determining the volume of the lead precipitate in the manner already mentioned and correcting the polariscopic reading of the volume of the precipitate. The same samples were then clarified using Horne's method* and the results were compared.

Proceeding in this way we obtain the following results:—

No.[1]	Vol. of Ppt. c.c.	Polarisation usual method.	Polarisation corrected for vol. of ppt.	Polarisation Horne's method.	Difference.
1	·33	89·55	89·26	89·35	·09
2	·35	86·50	86·20	86·20	·00
3	·39	87·55	87·23	87·25	·02
4	·44	90·30	89·91	90·00	·09
5	·42	87·65	87·29	87·30	·01
6	·30	86·70	86·44	86·45	·01
7	·42	90·00	89·58	—	—
8	·25	97·40	97·15	97·20	·05

[1] Nos. 1-6, Muscovado Sugar. No. 7, Low-grade Crystals. No. 8, Yellow Crystals.

In order to ensure accuracy and to avoid errors in sampling low-grade sugars, in each case a considerable quantity of the sugar under examination was dissolved in water and the required quantities of this solution weighed out, instead of weighing the sugar directly, greater uniformity being attainable by this method.

From these results we may conclude that Horne's method is a distinct advance in the direction of accuracy, whilst its simplicity will commend it to all workers.

As the outcome of this investigation we recommend the following method of working as generally applicable:—

(1) Use a weight of 26 grammes of the sample of sugar, dissolve in distilled water and make up to 100 true cubic centimetres.

(2) Clarify by means of anhydrous basic lead acetate, avoiding excess.

(3) Polarize at the temperature at which the solution is prepared and correct for temperature by the formula, Polarisation + †(·00038 t) N,

* The weight of dry basic lead acetate used by us in our experiments was ·35 gms.

† If the temperature is below that of standardization, the correction will be — instead of +.

where t is the difference between the temperature of observation and that at which the instrument was standardized, and N is the Ventzke scale reading.

Working in this manner will, we believe, secure a high degree of accuracy and at the same time uniformity between those working under diverse climatic conditions. We therefore commend this method to the careful consideration of those responsible for securing uniform methods of sugar analysis, whether for official or technical purposes.

Correspondence.

FIVE-ROLLER MILLS.

To the Editor of "The International Sugar Journal."

Sir,—Referring to your correspondence column we note Mr. McNeil's remarks regarding five-roller mills, wherein he gives the date that his firm commenced business as 1st October, 1881, and we beg to apologise to him if we are in error.

We have examined our books and find we have an order in our books for a five-roller mill on the 20th of September, 1881, so that we at least commenced to make five-roller mills before the firm of Messrs. Aitken & McNeil had started business. We thank Mr. McNeil for giving us the date when he commenced business, so that we are hereby enabled to state the true facts of the case.

Five-roller mills are made by most firms engaged in the construction of sugar machinery, but the proportion is very small as compared with three-roller mills arranged for double or triple crushing, with splitting or crushing rollers in front of the first mill. The advantages and disadvantages of the five-roller mill are a matter of opinion on which both engineers and planters do not agree, which is borne out by the small proportion of five-roller mills made as compared with the other mills, as above stated.

Yours truly,

For Harvey Engineering Co., Ltd.,

James Harvey, *Director*.

10th July, 1905.

MONTHLY LIST OF PATENTS.

Communicated by Mr. W. P. Thompson, C.E., F.C.S., M.I.M.E., Chartered Patent Agent, 6, Lord Street, Liverpool; and 322, High Holborn, London.

ENGLISH.—Applications.

11838. J. Wetter, London (communicated by M. Weinrich, United States). *Process for purifying masse-cuite syrups or impure sugar solutions.* 6th June, 1905.

13214. J. Higginbottom, Liverpool. *Improvements in whizzing, draining, or drying washed wheat, cereals, sugar, granular matter, ores, minerals and the like.* 27th June, 1905.

14095. J. Higginbottom, Liverpool. *Improvements in washing and rinsing wheat, cereals, sugar, granular matter, ores, minerals and the like.* 8th July, 1905.

Abridgments.

16262. A. Börner, Vienna, Austria. *A new or improved process for the manufacture of starch-like or amyloid-like substances and sugar.* 22nd July, 1904. This invention relates to the process for the manufacture of starch-like substances from cellulose and substances containing cellulose, such as sawdust, wood shavings, peat grass, and the like, consisting in the treatment of the cellulose with more or less heated dilute mineral acid, organic acid, dilute caustic alkali, more particularly caustic soda, borax lye and the like, the starch-like material separated from the cellulose, and if necessary from resin and the like, being precipitated by suitable means, for instance, by the addition of common salt.

10664. M. F. Ewen and G. H. Tomlinson, City of Chicago, County of Cook and State of Illinois, United States of America. *Process for converting wood cellulose into sugar.* 9th May, 1904. This invention relates to the process of converting cellulose, which consists in placing a quantity of the cellulose in a closed vessel, introducing therein a suitable quantity of the gaseous product derived from heating a solution of sulphurous acid, and heating the mixture to a temperature from 120° to 160° Centigrade until the conversion is effected.

16546. S. Stein and M. Loewenthal, both of Liverpool. *An improved manufacture of sugar.* 27th July, 1904. This invention relates to the manufacture of levulose by pulping or disintegrating dahlia bulbs, chicory roots, or the like, and heating and saccharifying the liquor obtained with the aid of the natural organic acids present in the liquor.

16546A. S. Stein and M. Loewenthal, both of Liverpool. *Improvements in the manufacture of inulin.* 27th July, 1904. This invention relates to the extraction of inulin from the bulbs of dahlia, roots of chicory, and the like, by pulping, neutralising the pulp, clarifying the warm solution and precipitating the impurities by the use of a suitable re-agent, and finally precipitating the inulin from the solution.

3972. V. Schütze, Riga, Russia. *Process of and apparatus for the production of crystals from sugar solutions and the like.* 25th February, 1905. This invention relates to a method of obtaining large well-formed crystals from hot saturated solutions, especially of sugar, directly from the syrup in one operation, characterised by this, that both the concentration and the crystallisation operations take place in a single vacuum apparatus kept constantly in motion, in such wise that the mother liquor concentrated in the first part of the apparatus is entirely cooled in the second part of the apparatus down to the external temperature or even less, while remaining in vacuo throughout, and therefore leaves the apparatus as solution from which the crystals have been entirely separated.

GERMAN.—Abridgments.

160369. Adolf Hinze, Rositz, South Africa. *Apparatus for washing sugar and the like.* 18th March, 1904. This invention relates to an apparatus for washing sugar and the like, in which the washing fluid flows in counter-current to the sugar mass which is passed continuously through the apparatus, which is divided into several compartments, by means of a worm conveyor, and the principal feature is the combined arrangement of perforated scoops and straining surfaces arranged alternately above and below on partitions.

160670. Adolf Guder, Ratisbonne. *A vertical evaporating apparatus in which the heating of the fluid takes place in boiling down pipes round which hot steam flows, and in order to obtain a circulation the rising current of fluid is separated from the descending one.* 23rd February, 1904. In this invention the chief feature consists in the fluid being only conveyed to certain definite, preferably outer, groups of tubes, and this is done by discharge nozzles proceeding from a fluid distributer discharging above the upper edge of a downwardly projecting, checking and conducting, ring, separating the inner from the outer groups of tubes.

160808. Maschinenbau-Akt.-Ges. vormals Breitfeld Danek & Co., Prague, Carolinental. *An apparatus for packing cube sugar in boxes or the like.* 9th July, 1904. This relates to apparatus for packing cube sugar in boxes and the like in which a number of rows

of cubes are simultaneously gripped by two bars, movable against one another, of a frame and lifted by means of two handles and transferred to the box, and its characteristic feature is that one bar of the frame is made adjustable corresponding to the width of the box, whilst the other bar of the frame is composed of a number of independent pressure levers, each acting on a row of cubes, which are simultaneously lifted by the depression, by means of two keys, of a bar parallel to the frame bars, and, on the release of the keys pressed on the separate rows of cubes independently of one another, by the action of springs and consequently lift these rows of cubes when the frame is lifted.

160936. GUSTAV HILLEBRAND, Werdohl, Westphalia. *A shredding knife having on its underside a support arm formed with a cylindrical surface.* 2nd December, 1903. This improved shredding knife is characterised by its support arm having the form of a section of a hollow cylinder the under face of which rests in a suitably formed cylindrical recess of the knife holder and in the upper face of which a bar adjustable by means of screws is placed, the form of which is adapted to this surface, so that after loosening the screws the knife may be adjusted by turning and changed. The shredding knife is also characterised by the attachment bar (*g*) being able to be adjusted against the cutting edge of the knife by being turned, after the screws have been slackened.

IMPORTS AND EXPORTS OF SUGAR (UNITED KINGDOM)

To end of June, 1904 and 1905.

IMPORTS.

Raw Sugars.	Quantities. 1904. Cwts.	Quantities. 1905. Cwts.	Values. 1904. £	Values. 1905. £
Germany	3,607,137	1,769,736	1,592,954	1,154,259
Holland	80,176	76,636	32,935	55,877
Belgium	166,624	274,915	70,600	206,066
France	102,137	102,073	45,959	75,708
Austria-Hungary	676,136	253,628	305,200	182,622
Java	925,070	1,271,923	380,837	942,159
Philippine Islands	....	....	....	....
Cuba	....	....	....	....
Peru	523,654	690,816	234,828	499,755
Brazil	81,793	27,996	31,039	18,087
Argentine Republic	....	....	....	....
Mauritius	255,172	139,034	93,355	78,350
British East Indies	112,107	332,571	45,395	179,688
Br. W. Indies, Guiana, &c.	708,236	724,581	454,173	610,576
Other Countries	363,348	610,655	165,865	436,314
Total Raw Sugars	7,601,590	6,274,564	3,453,140	4,439,461
Refined Sugars.				
Germany	5,795,579	4,895,780	3,241,432	4,109,798
Holland	1,554,612	672,761	911,987	591,567
Belgium	222,051	124,133	126,296	108,541
France	1,105,531	637,577	599,977	539,342
Other Countries	163,120	268,059	86,295	219,754
Total Refined Sugars	8,840,893	6,598,310	4,965,987	5,569,002
Molasses	869,088	1,158,508	160,729	235,029
Total Imports	17,311,571	14,031,382	8,579,856	10,243,492

EXPORTS.

British Refined Sugars.	Cwts.	Cwts.	£	£
Sweden	1,770	184	702	168
Norway	12,541	9,908	6,529	7,885
Denmark	60,310	39,648	30,616	30,494
Holland	27,579	36,713	14,354	30,155
Belgium	5,683	2,977	3,029	2,198
Portugal, Azores, &c.	9,035	8,153	4,798	6,316
Italy	2,457	1,344	1,159	964
Other Countries	157,336	116,139	97,407	109,733
	276,711	215,066	158,594	187,913
Foreign & Colonial Sugars.				
Refined and Candy	15,320	10,080	10,375	9,683
Unrefined	53,820	28,736	29,377	22,214
Molasses	634	992	343	378
Total Exports	346,485	254,874	198,689	220,188

UNITED STATES.

(Willett & Gray, &c.)

(Tons of 2,240 lbs.)	1905. Tons.		1904. Tons.
Total Receipts, Jan. 1st to July 20th ..	1,052,187	..	1,108,650
Receipts of Refined ,, ,, ,, ..	748	..	314
Deliveries ,, ,, ,, ..	972,903	..	1,097,569
Consumption	899,555	..	983,347
Importers' Stocks July 19th	79,284	..	23,242
Total Stocks, July 26th	220,000	..	166,013
Stocks in Cuba, ,, ...	300,000	..	106,500
	1904.		1903.
Total Consumption for twelve months ..	2,727,162	..	2,549,643

CUBA.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1904 AND 1905.

(Tons of 2,240lbs.)	1904. Tons.		1905. Tons.
Exports	896,073	..	705,005
Stocks	161,819	..	351,879
	1,057,892	..	1,056,884
Local Consumption (six months)	20,900	..	21,790
	1,078,792	..	1,078,674
Stock on 1st January (old crop)	94,835	..	—
Receipts at Ports up to June 30th	983,957	..	1,078,674

Havana, 30th June, 1905. J. GUMA.—F. MEJER.

UNITED KINGDOM.

STATEMENT OF IMPORTS, EXPORTS, AND CONSUMPTION FOR SIX MONTHS ENDING JUNE 30TH.

SUGAR.	IMPORTS. 1903. Tons.		IMPORTS. 1904. Tons.		IMPORTS. 1905. Tons.	EXPORTS (Foreign). 1903. Tons.		EXPORTS (Foreign). 1904. Tons.		EXPORTS (Foreign). 1905. Tons.
Refined	454,399	..	442,045	..	329,915	1,048	..	766	..	504
Raw	290,625	..	380,079	..	313,728	1,516	..	2,691	..	1,437
Molasses	37,401	..	43,454	..	57,925	60	..	32	..	49
Total..........	782,425	..	865,578	..	701,568	2,624	..	3,489	..	1,990

	HOME CONSUMPTION. 1903. Tons.		1904. Tons.		1905. Tons.
Refined	428,098	..	453,292	..	326,758
Refined (in Bond) in the United Kingdom	—	..	246,948	..	250,695
Raw	270,811	..	62,650	.	50,081
Molasses	33,115	..	41,046	..	56,070
Molasses, manufactured (in Bond) in U.K.	—	..	31,170	..	25,781
Total	732,024	..	835,106	..	709,385
Less Exports of British Refined....................	19,439	..	13,835	..	10,753
Total Home Consumption of Sugar	712,585	..	821,271	..	698,632

Stocks of Sugar in Europe at uneven dates, July 1st to 26th, compared with previous Years.

In thousands of tons, to the nearest thousand.

Great Britain.	Germany including Hamburg.	France.	Austria.	Holland and Belgium.	Total 1905.
147	516	433	231	67	1395

	1904.	1903.	1902.	1901.
Totals	1900 ..	1998 ..	2113 ..	1191

Twelve Months' Consumption of Sugar in Europe for Three Years, ending June 30th, in thousands of tons.

(Licht's Circular.)

Great Britain.	Germany.	France.	Austria.	Holland, Belgium, &c.	Total 1904-5.	Total 1903-4.	Total 1902-3.
1602	1023	630	466	175	3891	4126	3435

Estimated Crop of Beetroot Sugar on the Continent of Europe for the current Campaign, compared with the actual crop of the three previous Campaigns.

(From Licht's Monthly Circular.)

	1904-1905.	1903-1904.	1902-1903.	1901-1902.
	Tons.	Tons.	Tons.	Tons.
Germany	1,575,000 ..	1,927,681 ..	1,762,461 ..	2,304,923
Austria	893,000 ..	1,167,959 ..	1,057,692 ..	1,301,549
France	625,000 ..	804,308 ..	833,210 ..	1,123,533
Russia	940,000 ..	1,206,907 ..	1,256,311 ..	1,098,983
Belgium	173,000 ..	203,446 ..	224,090 ..	334,960
Holland	135,000 ..	123,551 ..	102,411 ..	203,172
Other Countries .	340,000 ..	441,116 ..	325,082 ..	393,236
	4,681,000	5,874,968	5,561,257	6,760,356

THE

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NOTES AND COMMENTS.

The Paris Sugar Gamble.

Gambling in sugar futures has always been a stock transaction of Paris speculators; but we question if ever a greater failure has been recorded than that which befel one of these individuals just lately. This was a Member of Parliament, M. Jules Jaluzot, who sits in the Chamber on the Nationalist benches. He is principal proprietor of the large Printemps emporium, and owns two newspapers besides. Not content with his already large income—he was said to be drawing £60,000 per annum from the emporium alone—he has for some years been carrying on huge speculations in sugar. His latest attempt was the biggest of all. Buying for a rise, his operations involved some three million sacks of sugar. Needless to say, this quantity only existed in a speculative sense, and had no actual existence. Prices, however, instead of stiffening, declined steadily. As a consequence, M. Jaluzot was unable to meet his liabilities, and his losses are put at anything between £600,000 and £800,000. Several other firms have failed through this deal, including Messrs. Emile Simon & Co.

It is pretty evident that the long bull and bear struggle, which has been going on in the Paris sugar market for the past ten months, has tended to keep prices up much longer than would otherwise have been the case. It is therefore a matter of some satisfaction to note

that the principal agitator has not secured the *coup* he desired, but has instead burnt his fingers very badly. It is a pity that such purely speculative dealings, possessing as they do such far-reaching results, are not rendered illegal. If, however, there is any truth in the report that the French Government are going to inquire into the legal aspects of the affair, it is to be hoped they will discover a *modus operandi* for preventing the recurrence of similar disasters. This big failure is only one more illustration of the folly of stock exchange speculations, where one or two individuals endeavour to corner a market; but we fear it will be some time yet ere the responsible Governments will summon up courage and grapple with the problem by making such transactions a crime. After all, public opinion will have to take the first step and clamour for this reform. Until it does so, the populace at large will continue to pay every now and then enhanced prices for certain commodities just to enable some daring speculator to secure a fortune, or lose one when it was almost within his grasp.

Cuba's Attitude to the United States.

In the interesting account of Dr. Herzfeld's trip to Cuba, to be found on another page, reference is made to the deep-rooted animosity which the Cubans show to the Americans. No real explanation of this attitude is forthcoming and at first sight it seems ungrateful, considering the freedom the American intervention conferred on Cuba. But the Cubans seem to have a suspicion that the American help was far from disinterested; and that the United States had as an ultimate object the capture of the Cuban trade. Whether this suspicion be well-founded or not, it is clear the Cuban Government realize that an arrangement which limits the number of countries to which they can export their staple product, sugar, is not altogether a blessing. They see that if the United States alone will take their sugar, they also will be in a position to govern prices, and consequently the Cubans would sell at a disadvantage. The latter have, therefore, taken a step which should have a far-reaching effect. The discussion by the Brussels Sugar Commission last session of Cuba's fiscal system, while not brought to any definite issue, seems to have awakened Cuba to the danger that she is threatened with, should the Powers signatory to the Brussels Convention decide to penalize her sugar. Therefore, while not showing any desire to become a party to that Convention, she has resolved to reduce her import duties to the limits allowed by the Convention. She will henceforward be able to have some choice of markets for her sugar, and any attempts on the part of the American Sugar Trusts to squeeze her profits will have much less chance of success.

It is true the duties reduced refer only to raw sugar, but Cuba does not, and is never likely to, export refined sugar; all she refines is

consumed in the island. So we do not think her case will trouble the Brussels Commission at their next sitting.

We welcome this latest conformity to fair trade; it opens up to the British consumer an immense source of supply, and will do much to prevent any future recurrence of the disastrous high prices of last winter. As the United States are exploiting sugar production in both Porto Rico and the Philippines, their demands on Cuban sugar will not be so great in a year or two. The Cubans will, therefore, do well to tap other markets. At present no Cuban sugar whatever reaches the United Kingdom; and the excess of beet over cane entering this country at present is still far too large to prevent the market from being influenced by the character of the beet crop. Only when cane *exceeds* beet, and several sources of cane sugar exist in reserve, will a really steady market be obtained. And this is a desideratum we hope to see, ere many years are past.

Sugar in Behar.

An old planter, writing to the *Englishman* of Calcutta, gives his reasons for the failure of the Behar sugar industry in the forties. When it was first started no attempts were made to carry on either the agricultural or manufacturing branches on a scientific basis. No attempts at manuring were made, and no rotation of crops was thought of; consequently, the originally rich soils got speedily exhausted, and the production fell from 60 maunds per bigha to $2\frac{1}{2}$*. The sugar was badly made, and after bagging became a sticky mass, so that it fetched next to nothing on the Calcutta market. Open pan boiling was generally employed; but one factory which installed vacuum pans turned out a more successful product. The exhaustion of the lands was, however, the principal cause of failure, and when better prices began to be secured for indigo, the cultivation of the latter plant speedily superseded that of the sugar cane.

But with the decline in the demand for natural indigo, which has been evident for some years past, a return to the cane sugar industry is not surprising. The advent of better machinery and more scientific field work is producing very different results to what were obtained half-a-century ago; and excellent sugar is now turned out, which meets with a ready sale. The soils of Behar are not, however, volcanic or virgin soils, and a careful rotation of crops, combined with judicious manuring, is necessary. Irrigation canals are now being constructed, and these will make up for the somewhat uncertain rainfall. The most up-to-date establishment, that of the India Development Ltd., is doing very well; both the sugar and molasses sell very readily, and it is not necessary to resort to rum manufacture.

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* 1 maund = $82\frac{2}{7}$ lbs.; 1 bigha = $\frac{1}{3}$ acre.

Patent Levulose.

Mr. Sigmund Stein, of Liverpool, has, we learn, patented a process of cheaply manufacturing Levulose and Inulin and supplying them in the form of sugar, bread, milk, or other foods for diabetics. It is pointed out that so far the only substance which has been available as sweetening material for diabetics is saccharine, an expensive derivative of coal tar. But various medical authorities have declared that it has a deleterious effect, as it destroys the enzymes. Consequently a demand arises for a substance which is not only non-injurious, but which has nourishing properties equal to those of ordinary sugar.

The Patentee has succeeded after long experimentation in finding plants from which he can extract levulose in, no doubt, sufficient quantity to supply the demand. He proposes to manufacture therefrom foods for diabetics; amongst them, bread, which he claims will contain all the constituents which can be assimilated by the system and have no injurious percentage of starch. Such foods will also be of paramount value to consumptives, and as a useful remedy for wasting diseases of infants and young children.

Apart from its employment as a medicine, levulose is of use for various industrial purposes. It is five times sweeter than ordinary sugar, is perfectly soluble in water, and has the advantage that it will not crystallize out in solution. So far, however, its high cost of production has rendered its general application out of question. Yet it could be advantageously employed in the confectionery trade; in the brewing industry, where it would replace glucose and invert sugar; in the manufacture of preserves, marmalade, artificial honey, and aerated waters; and for the purpose of flavouring wines. This new process will doubtless enable this substance to be turned out at a moderate price. A Company has been formed to work the patent.*

A New Work on Sugar.

We have pleasure in drawing attention to a new work on sugar, entitled "Sugar and the Sugar Cane," by Mr. Noël Deerr, the author of "Sugar House Notes and Tables," a hand book for factory managers and chemists. His latest attempt is a bold one, and covers a large ground. Few branches of the sugar industry fail to find mention in his work; and, however short of the ideal certain sections of the treatise may prove to those persons who are well up in their particular study, Mr. Deerr deserves every credit for having attempted to combine in one readable whole matter which has hitherto been but sparingly published, each in its own section, by the various experts. The few comprehensive works on the sugar cane which have been issued ten or twenty years ago are now hopelessly out of date; and much new information of a valuable character which has since

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* The Levulose Co., Ltd., 90, High Holborn, London, W.C.

appeared has been published in foreign languages, thus rendering it inaccessible to the majority of English readers. Mr. Deerr has now endeavoured to give us their gist, and his compilations from Dutch and German writers will be highly acceptable. A feature of the book is the splendid set of coloured plates illustrating well-known sugar canes; no such fine representations have yet, to the best of our knowledge, appeared in any English work. Particulars of this book will be found in our advertisement columns.

THE CRISIS IN THE SUGAR MARKET.

In the year 1902, thanks to the State Bounties and the Cartel Bounties—especially the latter—we had a great, an unprecedented fall in the price of sugar. Stocks accumulated so prodigiously that the price fell to a point more than 30 per cent. below the natural cost of production. Producers—even bounty-fed—became grievously alarmed, and they applied the proper remedy, reduced production. But this was not sufficient. Prices rose slightly, but remained below cost. Nature, however, came to the rescue and did what the producers desired. A great drought in 1904 reduced the output of the European beetroot crop by more than a million tons. Speculators rushed in and prices rose far above what circumstances justified. If the crop of 1904 had given an average yield prices would have remained below cost, and it would have been necessary to make a further reduction in the sowings for 1905. This necessity has been avoided; but the rise unfortunately led to large contracts for roots at high prices, and instead of a reduction we see a large increase in prospect for the crop of 1905-6.

In the meantime the high prices have thrown consumers back upon invisible stocks, so that the European consumption for the first ten months of the present campaign shows a falling off, as compared with the abnormal increase in the corresponding period of 1903-4, of more than 350,000 tons. The falling off in the beetroot crop caused by the drought amounted to more than a million tons, but was partially counterbalanced by an increase of nearly 300,000 tons in the cane sugar production. Adding to this compensation the 350,000 tons of apparent reduced consumption, the net loss of supplies becomes much more manageable, especially as stocks at the beginning of 1904-5 were still excessive.

All these facts were—or ought to have been—known or anticipated last January. Warnings were given that invisible stocks would come to the rescue, as they always have on former occasions of speculative boom. But operators for the rise were, as usual, deaf to all warnings. They faced the day of reckoning and liquidated their May and August engagements in presence of a perfect panic. The big operator in Paris has failed for £600,000, and has dragged down with him many large houses. Little speculators in large numbers

have gone with the big ones; and we hear of butchers, bakers, grocers, hairdressers, and ballet girls who are now bemoaning their losses in Paris.

There are many morals to be drawn from all this, but we leave the more manifest reflections in order to point to the real fact which underlies this sad story. The world depended practically for its sugar supply on the European beetroot crop. If that were to fail supplies would be reduced by more than 50 per cent. When it even partially fails prices are bound to go up far beyond their normal range. The history of the sugar market for the last twenty years is a conclusive proof of this fact. And why is it so? Simply because the production of the European beetroot sugar has been pushed and stimulated and bolstered up by enormous bounties. But for them the overwhelming stocks of 1901-4 would never have accumulated, and prices would never have fallen to 6s. per cwt. But for them a drought in a small portion of Europe would never have reduced the production of the world by 926,917 tons, and prices would never have risen to 16s. per cwt. The facts are very simple and very manifest, and yet party politicians want to make the ignorant elector believe that the abolition of bounties is the cause of all this disturbance. It is quite clear that if the bounties had not been abolished the disturbance would have been far more intense. Germany and Austria would soon have been masters of the situation, and cane sugar would have become a thing of the past. Let these politicians tell us what would then have happened when the next drought set in in those two countries.

This crisis—caused entirely by the bounties—has left an awkward legacy behind it. The great rise, which culminated in January, has caused the European producers of beetroot sugar to sow 1,879,000 hectares this year instead of 1,610,000, an increase of more than 16 per cent. There is every prospect of a good crop and a large yield of sugar. Excessive supplies will again be the order of the day. As the bounties were the cause of the great fall, and, by making us dependent on beetroot for our supplies, were also the cause of the subsequent rise, it is manifest that the unfortunate increase in the present beetroot crop must also be laid to the door of the bounties—an aftermath. It will throw us back for another year or two in restoring the sugar production of the world to its natural condition and opening all the natural sources of production to free competition on the basis of the cost of production. If the present quotations for new crop beetroot are a reliable indication of the course of prices during next year there will be no encouragement to natural producers to expand and launch out into new ventures. Prices will still remain below the cost of production and we shall have to wait for the natural remedy. We shall, however, have one comfort—politicians must find some other grievance than the great rise in the price of sugar.

SIMPLE METHODS OF CHEMICAL CONTROL.

By T. H. P. Heriot, F.C.S.

(Continued from page 372.)

Weighing and Measuring.

It is necessary to repeat that the object of these papers is to enable the reader to judge for himself concerning the practical utility of chemical knowledge in the sugar factory.

As no mere description, however accurate, can fully represent the object described, so no scientific statement will appeal to the practical man with the force of an experiment carried out with his own hands, or of an observation made with his own eyes. Is it then too much to expect him to agree to a *practical* test of methods which have long been adopted by his competitors? Those who are disinclined to gain new experience when it costs something need look for no instruction from these papers. We must assume that the laboratory has been fitted up and furnished with the apparatus specified in the last chapter, and that the reader will forthwith practice what he reads. Some description of the instruments to be employed and instructions regarding their use will be necessary before entering upon the main subject before us.

Chemical tests are either qualitative or quantitative in character. The former are required when examining an unknown material in order to ascertain whether it contains this or that substance; the latter when it is further desirable to know the relative proportions of the constituents. For example, the qualitative composition of the sugar cane has long ago been ascertained, but because the component parts occur in very variable proportions the chemist is called upon to ascertain the quantitative composition of particular canes, of the juice expressed from them, and of the various products into which the juice is worked up.

Having seen that such quantitative analyses must necessarily be made on small samples, we may be prepared to find that the weights and measures used in the laboratory are of an entirely different order to the tons and gallons adopted in the factory.

The Metrical System.—From the Metre, or unit of length, is derived the Litre, or unit of volume, and the Gram, or unit of weight; the Gram being the weight of one cubic centimetre of water, measured at its maximum density. Larger and smaller measures are derived from these three by multiplying or dividing them by 10, 100, 1000, as shown below :—

Length.	Metre.		Volume.	Litre.		Weight.	Gram.
Millimetre	$=\frac{1}{1000}$	..	Millilitre	$=\frac{1}{1000}$	..	Milligram	$=\frac{1}{1000}$
Centimetre	$=\frac{1}{100}$	..	Centilitre	$=\frac{1}{100}$	..	Centigram	$=\frac{1}{100}$
Decimetre	$=\frac{1}{10}$	.	Decilitre	$=\frac{1}{10}$	..	Decigram	$=\frac{1}{10}$
Metre	= 1	..	Litre	= 1	..	Gram	= 1
Decametre	= 10	..	Decalitre	= 10	..	Decagram	= 10
Hectometre	= 100	..	Hectolitre	= 100	..	Hectogram	= 100
Kilometre	= 1000	.	Kilolitre	= 1000	..	Kilogram	= 1000

Instead of employing different words (*i.e.*, ounces, pounds, quarters, &c.,) to express multiples of one kind, it will be seen that metrical measures are distinguished by prefixes, which are the same for all similar multiples and can be committed to memory in a few minutes.

The direct relation between length, volume, and weight, may be illustrated as follows:—

Length.		Volume.		Weight.
1 Metre^3	=	1 Kilolitre	=	1000 Kilograms.
1 Decimetre^3	=	1 Litre	=	1 Kilogram.
1 Centimetre^3	=	1 Millilitre	=	1 Gram.

When this unified system is contrasted with that jumble of independent standards and diversity of weights and measures so dear to the British nation, the great simplicity and practical advantages of the metrical system will readily be seen. It has long been universally adopted for scientific work, and laboratory measurements are mainly concerned with grams and cubic centimetres.

In the factory a ton of material can be weighed to within, say, one pound. Let the former weight be represented in the laboratory by a sample weighing one decagram (less than half-ounce), it then follows that every pound weight in the factory will here be represented by $\frac{1}{2240}$th part of a decagram, say $4\frac{1}{2}$ milligrams ($\frac{1}{10000}$th part of an ounce).

As such minute weights may have no practical meaning to many of our readers, we submit an illustration from the mining industry. A gold-bearing ore, if favourably situated, can be worked at a profit though it contains only half an ounce of gold to the ton. How is the richness of such an ore ascertained? Samples are sent to the assayer's laboratory and submitted to certain smelting and refining operations by which the gold may be separated without loss. But the assayer's "ton" is only about 30 grams, and the above proportion of gold would be represented by half a milligram. He must therefore employ a balance capable of detecting the tenth part of one milligram (or the ten thousandth part of one gram). Here, then, is an instance of an important commercial undertaking being set on

foot and its operations controlled by weighing to the fourth decimal place.

The Chemical Balance.—The following instructions must be carefully studied before attempting to follow them:—The instrument being very delicate and therefore easily injured, the greatest care must be taken in unpacking the separate parts from the drawer of the case. Cleanliness being an absolute essential, the interior and exterior of the case will require a little polishing, and the metal parts of the balance should be rubbed over with a soft piece of wash-leather before being placed in position.

The only fixture in the case is a central pillar with horizontal arms which act as supports for the moving parts. The pillar itself is hollow, and encloses a rod which can be raised or lowered by turning the milled screw in front of the case. The top of this rod is furnished with an horizontal plate of agate.

Examining the loose parts, the brass beam of the balance is easily recognised by the central agate prism, the fine edge of which, when resting upon the agate plate just referred to, forms a fulcrum upon which the beam can swing with a minimum of friction. At either end of the beam are smaller agate prisms (directed upwards); these will eventually support two other agate plates connected with the hooks from which the pans are suspended.

In order that the slightest motion of the beam may be rendered visible, the long pointer is to be fixed at its centre, perpendicular to the direction of the length of the beam, and directed vertically downwards, so that the pointed end moves opposite the graduated ivory scale at the foot of the central pillar. This pointer projects *in front of the beam*, so that attention must be drawn to certain marks by which the front of the beam may be recognised. At one extremity will be found two small dots to indicate "left," and at the other extremity one dot to indicate "right"; the pans, stirrups, and hooks being also marked with one or two dots, according as they belong to the right or left side of the beam.

Unscrew the brass knob from the centre of the beam, and place the flat end of the pointer in its place, so that the pointer is on the marked side (or front) of the beam; the two pins on the pointer fitting into the holes provided for them in the beam. The knob is now replaced and screwed home upon the pointer. Wipe the beam clean and place it upon the supports in the balance case.

The hooks, from which the pans are suspended, are connected to small-grooved agate plates, which may now be placed upon their supports at either end of the beam; the hook marked with two dots going to the left hand side. The pivotted bar on each stirrup is set at right-angles to the fixed bar, to receive their respective pans, and then the stirrups are suspended from their proper hooks.

The complete balance should now appear as in *Fig. 4*.

It should stand at one end of the spare table, preferably facing a window, and must not be shifted after being adjusted. To complete this examination, reference must be made to the action of the horizontal supports. When not in use, the milled screw of the balance is always turned to the left, thus lowering the vertical rod which supports the central agate plate. Now, in this position, the beam rests entirely upon the rigid supports, the central agate plate being lowered out of contact with the central agate knife-edge on the beam. In the same manner, the two extremities of the supports (not shown in *Fig. 4*), are adapted to lift the grooved agate plates clear of the small agate knife-edges at either extremity of the beam.

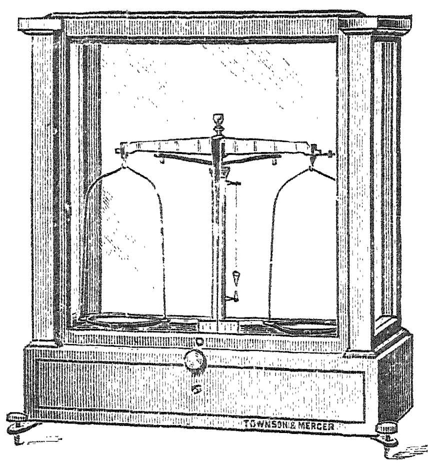

FIG. 4.

The "bearings" of the beam and pans are thus held out of gear until a weighing has to be made, so that the addition of weights to either of the pans has no effect whatever. But on turning the milled screw slowly to the right, the central agate plate is raised into contact with the central knife-edge, and, rising still higher, lifts the beam clear of its supports, the grooved agate plates being simultaneously raised upon their knife-edges so that the pans hang freely.

Adjusting and Testing the Balance.—The instrument must first be accurately levelled, by means of the three screws underneath the case until the bob of the pendulum is exactly over the the fixed point attached to the central pillar. The front of the case being closed, the milled screw is gently turned to the right as far as it will go. If the free end of the pointer remains steady opposite the centre (or zero) of the graduated ivory scale, the balance is probably correct, and the milled screw is slowly reversed. But more generally the pointer

moves away from the centre of the scale; in which case, count the divisions it moves over, first on one side and then on the other side of the zero line. If these agree the balance is correct, but the beam may be allowed to swing once or twice to make quite sure. The motion of the beam should not be sufficient to carry the pointer beyond the last division of the scale. To bring the oscillating beam once more to rest, watch the movements of the pointer, and, when it approaches the zero line, gently reverse the milled screw.

(NOTE.—Unless this precaution is always observed the agate knife-edges receive a sudden jar which may permanently effect the delicacy of the instrument.)

Should the foregoing tests fail to cause the beam to swing, it may be necessary to turn the milled screw somewhat more rapidly, watching the index pointer closely. A few minutes' practice will render this preliminary operation easy.

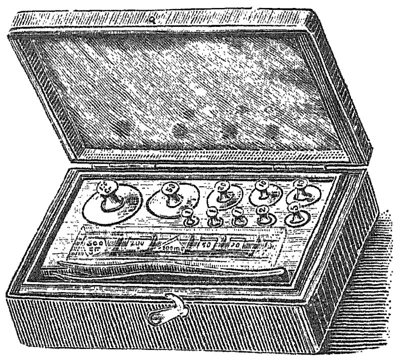

FIG. 5.

If the beam swings unequally, the pointer covering, say, seven divisions to the right and two to the left, it is obvious that the left side of the balance is heavier than the right. Assuming that all the parts are clean, and that the pans and hooks are attached to their proper ends (as indicated by the marks referred to above), the balance must be adjusted by means of the small nut on the threaded pin which projects from the right hand extremity of the beam. On the above supposition, this nut must be moved slightly away from the centre of the beam (in order to increase its apparent weight by increasing the leverage it exerts upon the central fulcrum). This is effected by a very slight turn of the nut in the required direction. The case being again closed, the milled screw is turned to the right as before. With a little patience this adjustment is soon completed; the pointer swinging an equal number of divisions on either side of the zero of the scale.

A few words now concerning the weights, illustrated in *Fig. 5.* These comprise brass weights, marked 100, 50, 20, 10, 10, 5, 2, and three 1 gram weights; then come the tenths (decigrams) made of aluminium foil and marked ·5, ·2, ·2, ·1; then the hundredths (centigrams) marked ·05, ·02, ·02, ·01; and, lastly, the thousandths (milligrams) made of aluminium wire and distinguished only by their shape, ·005 having five sides, ·002 two sides, and ·001 being a short straight piece. These weights must never be handled, but are lifted from the box and returned to it by means of the forceps supplied for the purpose. The box must be kept closed when not in use. If a weight accidentally falls, search should be immediately made for it, as it would be completely ruined if trodden upon. When found it should be wiped scrupulously clean with a soft piece of wash-leather.

The balance being now ready for use, the quality of the workmanship should be tested by placing the ·001 (milligram) weight on one of the empty pans, and turning the milled screw. If the beam is not caused to swing, the pointer will probably be deflected, say, one division from the zero where it will remain steady. But if the beam oscillates it will be found that the deflection of the pointer becomes more conspicuous; it may, for example, move three divisions to one side and five divisions to the other. The indications of the pointer are thus shown to be more delicate when the beam is in gentle motion than when at rest. Reverse the milled screw at the moment when the pointer approaches the zero and restore the weight to its place in the box. A similar but much more severe test is then made as follows:—In the centre of one pan place the 100 gram weight, and in the other pan place the 50, 20, 10, 10, 5, 2, and three 1 gram weights, so that each pan carries its maximum load of 100 grams. Watching the pointer, turn the milled screw very cautiously and ascertain whether the two pans are equally weighted (as they should be if the weights are accurate). The motion of the beam will now be somewhat slower, but the pointer should still travel equal distances on each side of the zero of the scale, or, if there is any inequality, this must be accurately noted. Bring the beam to rest as before, add the milligram weight to one of the pans, and repeat the test. The pointer will now move, say, four divisions on one side and five divisions on the other, and these indications should be reversed if the milligram be transferred to the other pan. Reverse the milled screw and replace the weights in the box. Having thus proved that the balance will do what the makers claim for it, a complete record of these tests should be preserved for future reference, as it will be necessary to repeat them from time to time.

Using the Balance.—Always reserve the right hand pan for the weights and the other pan for the object to be weighed; the milled screw being turned by the left hand, leaving the right hand free to

manipulate the weights by means of the forceps. When weighing an object, a rough guess is first made as to the largest weight to be placed on the pan, the other weights are then "tried" in regular order, from the highest downwards. In making such "trials" with the larger weights, the milled screw should only be turned sufficiently to cause the pointer to move a short distance from the zero of the scale. If the screw be turned completely to the right, the pointer merely moves beyond the limits of the scale, and gives no better indication; time is lost, and the agate surfaces are submitted to unnecessary friction. The beam should only be fully raised when the weights on both pans are nearly equal, only requiring the addition, or removal, of the milligram weights. After some experience in the use of the balance, the relative excess or deficiency of the "trial" weight may be quickly gauged from the rapidity with which the beam moves away from the zero of the scale when the milled screw is turned. To avoid mistakes in recording the weights used, these should be first ascertained and recorded by reference to the empty cavities in the box, and the result checked by reference to the weights themselves when restoring them to their places.

Skill in using the balance can only be acquired by practice, and with this end in view, a number of coins should be separately weighed and then two or more coins reweighed together, and the results checked against each other. These instructions may fitly conclude with a few maxims:—

1. Never use the balance when in a hurry.

2. Open and close the case without shaking the instrument, and always close the case and weight-box after use. On no account open or close the case when the beam of the balance is raised.

3. Watch the pointer when turning the milled screw, and never reverse the screw unless the pointer is at, or near, the zero line.

4. Make the final observation of the pointer with the case closed.

5. Always bring the beam to rest before adding or removing anything from the pans.

6. Aim at the highest possible accuracy by never resting content with a weight which is "nearly right." When accuracy has been acquired, it will be time enough to decide what degree of accuracy may be necessary in special cases.

Measurement of Volume in the laboratory is rendered easy by the use of graduated instruments. The flask, shown in *Fig. 6*, holds exactly 500 c.c. (cubic centimetres) or half a litre, when filled to the level marked on the neck. The width of the latter being relatively small, the addition of a single drop in excess can be easily detected by the eye. The flask is therefore capable of measuring to within $\frac{1}{5000}$ part of its capacity, which is sufficiently accurate for most purposes.

In some cases, it is required to add a known volume of one liquid to a known volume of another liquid, when the neck of the flask may be marked in two places.

(NOTE.—Examine the flasks marked at 50 and 55, 100 and 110, 200 and 220 c.c. in each of which the volume occupied between the two marks is exactly one-tenth of the capacity of the flask when filled to the lower mark.)

The makers of these flasks being responsible for their capacity, all that has to be done is to fill them to the point indicated. Now, actual trial will show that the level of the liquid, when viewed sideways, does not appear as a straight line but as a curve, called a meniscus (this curvature being caused by capillary attraction of

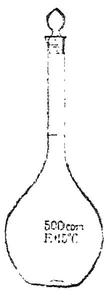

FIG. 6.

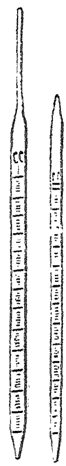

FIG. 7.

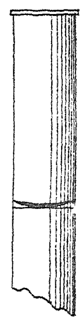

FIG. 8.

glass for liquids). Consequently, the volume is accurately adjusted when the lowest point of this curve appears to touch the horizontal line marked on the flask (see *Fig. 8*).

Small volumes must be measured more accurately than large volumes if the same *relative accuracy* is to be maintained throughout. The narrow tubes, or pipettes, shown in *Fig. 7*, are graduated in separate cubic centimetres, and in tenths of one c.c., and manipulated as follows:—Holding the instrument near its upper end (between the second finger and thumb of the right hand), immerse the pointed end in the liquid of which a measured quantity is required. Applying the mouth to the top of the pipette, the liquid is drawn up by suction until the level rises above the zero mark; the mouth is then quickly replaced by the tip of the forefinger (of the right hand), which closes the top of the tube. The filled pipette can now be raised without any liquid

escaping from it, and is brought into a perpendicular position with the zero mark level with the eye. The pressure of the finger on the tube being slightly relaxed, liquid begins to slowly drip from the lower end of the pipette, while the level of the liquid in the upper part sinks towards the zero mark. As soon as the lowest point of the meniscus appears to touch the zero line, the pressure of the forefinger is renewed, and the downward motion of the meniscus thus arrested. The drop (or fraction of a drop) adhering to the exterior of the pipette is removed (by touching it with a finger of the left hand), and that remaining inside measures exactly 10 c.c. This volume may now be transferred to another vessel by merely removing the forefinger from the pipette which then empties itself, the last drop being blown out. If 8 instead of 10 c.c. are required, the top of the pipette is reclosed by the forefinger as soon as the descending meniscus reaches the 8 c.c. mark. These manipulations are performed in a few seconds after a little practice.

In filling the measure flask, the lip or spout of the vessel containing the liquid should touch the neck of the flask, causing the liquid to flow down the interior surface of the flask without splashing or frothing. With a steady hand, the pouring may be continued exactly up to the mark, but we recommend the following plan. The flask (filled nearly to the mark) is held vertically with the mark level with the eye. Sufficient liquid is then added from a short pipette to bring the level in the flask up to the mark. The pipette need not in this case contain a measured quantity of liquid and merely serves to regulate the addition to the flask.

These measurements should be practiced first with water, which gives a clearly defined meniscus. When the finger has been trained to work in unison with the eye, the measurements should be repeated with mill juice from which all foam has been carefully removed.

(To be continued.)

THE POLARIMETRIC DETERMINATION ON SUCROSE.

By Dr. F. G. Wiechmann.

Under the above given title, an article has appeared in the *West Indian Bulletin*, Vol. VI., 1, pp. 52-60, 1905, by the Hon. Francis Watts, C.M.G., D.Sc., F.I.C., F.C.S., and Mr. H. A. Tempany, B.Sc., A.I.C., for a copy of which the present writer is indebted to the courtesy of the authors.

In their valuable paper Messrs. Watts and Tempany carefully discuss papers by the present writer on "The Question of Temperature-Influence on the Specific Rotation of Sucrose" (International Sugar Journal, Vol. II., 1900, p. 491), and on "A Restant Source

of Error in Optical Sugar Analysis" (International Sugar Journal, Vol. V., 1903, p. 376), as well as a paper by Dr. W. D. Horne, "Dry Defecation in Optical Sugar Analysis" (Journal of the American Chemical Society, Vol. XXVI., 1904, p. 186; International Sugar Journal, Vol. VI., 1904, p. 31).

Messrs. Watts and Tempany reach the conclusion "that a very considerable error is introduced into the polarimetric determination of sucrose if no account is taken of the volume occupied by the lead precipitate," and state that: "When working at tropical temperatures in the neighbourhood of 30° C., the error produced by the volume of the lead precipitate to a large extent compensates the errors introduced by the effect of temperature on optical activity of sucrose, and on the quartz wedge of the Schmidt and Haensch polarimeter. Thus tropical observations in which no corrections are introduced, are more in accord with theoretically accurate readings, than those in which corrections are made for the effect of temperature on the optical activity of quartz and sucrose, while neglecting the effect of the volume occupied by the lead precipitate."

As the outcome of their investigation, Messrs. Watts and Tempany, having found Dr. Horne's method to be a distinct advance in the direction of accuracy, recommend the subjoined method of working as generally applicable:—

(1) Use a weight of 26 grammes of the sample of sugar, dissolve in distilled water and make up to 100 true cubic centimetres.

(2) Clarify by means of anhydrous basic lead acetate, avoiding excess.

(3) Polarize at the temperature at which the solution is prepared and correct for temperature by the formula, Polarization + (·00038 t) N, where t is the difference between the temperature of observation and that at which the instrument was standardized, and N is the Ventzke scale reading.

There is one point in the interesting paper of Messrs. Watts and Tempany with which the present writer must take issue; this is their recommendation to make a correction for an alleged influence of temperature on the specific rotation of sucrose, which the authors believe to have found.

The experimental basis on which their conclusion rests consists of two separate polarizations of a sample of "pure sugar from Kahlbaum . . . carefully dried before use." These two solutions were prepared with distilled water at 30° C., and were read at, respectively, 29·3° C., polarization equals 99·765°, and the other read at 29·7° C., polarization equals 99·79° on a Ventzke scale, triple-field, Schmidt and Haensch, white light polarimeter.

After having introduced a correction for the contraction due to change of temperature during polarimeter observations, also a further correction allowing for the change of volume from *true* cubic centimetres to Mohr cubic centimetres, and also the Jobin correction allowing for the influence of temperature on the quartz wedges of the polarimeter, the authors find the two polarizations, thus corrected, to be respectively 99·705° and 99·748°.

These two values are in close agreement, differing from one another by less than 0·05° Ventzke.

Concerning these values, Messrs. Watts and Tempany state: "We believe we are correct in attributing this difference to the effect of temperature upon the optical activity of sucrose. These results are in as close agreement with those of Wiley and Harrison as can be expected when the observations are made with a polarimeter."

"From the above observations we conclude that changes of temperature (up to about 30° C.) causes a lowering of the reading on the Ventzke scale, which may be reckoned by the formula: Polarization + (·00023 t) N, where t is the difference of temperature of observation from that at which the instrument was standardized, and N is the scale reading observed."

The all important point at issue is, whether, or no, the sucrose used in these two experiments was really 100% pure sucrose. However, as far as the writer can discover from a careful study of Messrs. Watts and Tempany's paper, this contains no experimental evidence whatsoever showing that the "pure sugar from Kahlbaum" which they used, was really 100% pure sucrose.

Even if it were to be assumed that that preparation might, originally, have had a value of 100° Ventzke, it is respectfully submitted that this affords no guarantee that the sample, as used by Watts and Tempany, still retained that value.

In the first place, in warm damp climates there is always the undeniable risk of the sugar absorbing moisture from the atmosphere in the very process of weighing out the samples; this, of course, would determine a lower reading.

In the second place, it is very likely that the sucrose may have suffered a slight decomposition in the drying which it admittedly received before use.

How extremely likely it is that this may have occurred, will be readily acknowledged by all who have attempted the delicate and difficult task of preparing chemically pure sucrose.

In this connection it is of interest to recall the experience of Dr. Schoenrock (Zeitschrift des Vereins der Deutschen Zucker-Industrie, 1900, Vol. 50, p. 426), who found that a sample of sucrose prepared by Kahlbaum gave, when carefully dried in an air-bath, a specific rotation one-half of one per cent. lower than when dried over chloride of calcium in vacuo, and yet not the slightest trace of browning or

other change could be detected in the appearance of the air-dried sample.

In view of these circumstances, a direct polarization of the sucrose sample as used, *i.e.*, after drying, should have been made at the temperature at which the polarimeter of Messrs. Watts and Tempany was graduated. To judge by the correction-data used by these gentlemen (p. 392), this temperature of graduation would appear to have been 17·5° C. In case a determination at such temperature should have been precluded by the conditions obtaining in their laboratory, a gravimetric determination of the sample, by Fehling's solution, would have determined the true sucrose-content of the sample.

Regarding the statement of Messrs. Watts and Tempany, that their results are in close agreement with the results of Messrs. Wiley and Harrison, it may be of interest to refer to the comments of the present writer on Prof. Harrison's work (International Sugar Journal, Vol. III., 1901, p. 48).

As to the manner in which Prof. Wiley determined his factor for the influence of temperature on the specific rotation of sucrose, Prof. Wiley, at the Paris Session of the International Commission for Uniform Methods of Sugar Analysis, July, 1900, thus stated:—

"The total variation in rotation was determined, and that part of it due to change in specific rotation was found by calculating the magnitude of all the other variants, and subtracting this from the total variation observed. It is evident that the number obtained by me for the magnitude of the variation due to change in specific rotation, contains not only all the errors of observation, but also any errors which may have arisen by ascribing wrong values to any of the other variants."

That Prof. Wiley's doubts as to the correctness of his factor were only too well founded, would seem to have been thoroughly established by the fact, brought out in the recent trial of American sugar importers against the United States Government, where Government officers in charge of the polarization of sugar imported into New York testified under oath that the application of Prof. Wiley's "Table of Corrections to Polarizations" caused the test, in 30% or more, of the foreign sugars imported in New York, to run over 100%, the excess amounting to as high as 0·3° or 0·4° of one per cent.

In other words, application of the alleged Table of Corrections, used by the United States Customs officials, demonstrated that, apparently, one-third of all sugar imported into New York is not only chemically pure, but more tham chemically pure!

The importation of raw sugar into the United States in the years 1902 and 1903 exceeded 2,000,000 tons. On this basis, the additional duties thus exacted, *for sugar which has no existence*, amount annually to over $250,000.

If Messrs. Watts and Tempany will refer to the proceedings of the Third Session of the International Commission for Uniform Methods of Sugar Analysis, held in Paris, July 24th, 1900, they will there find that the resolution of the International Commission concerning the working temperature, which resolution was unanimously adopted, does away with the necessity of any and all corrections for any possible influence of temperature, even in tropical countries. The resolution reads as follows:—

"In general, all sugar tests shall be made at 20° C. The adjustment of the saccharimeter shall be made at 20° C.; one dissolves for instruments arranged for the German normal weight, 26 grams of pure sugar in a 100 metric cubic centimetres flask*, weighing to be made in air, with brass weights, and polarize the solution in a room, the temperature of which is also 20° C.; under these conditions, the instrument must indicate exactly 100·00°.

"The temperature of all sugar solutions to be tested is always to be kept at 20° C., while they are being prepared, and while they are being polarized.

"However, for those countries the temperature of which is generally higher, it is permissible that the saccharimeters be adjusted at 30° C. (or at any other suitable temperature) under the conditions specified above, and provided that the analyses of sugar be made at the same temperature."

PERSONAL IMPRESSIONS OF CUBA.

By Professor HERZFELD.

At the annual meeting of the *Vereins der Deutschen Zuckerindustrie* held at Dantzig in June last, a very long and interesting paper was read by Dr. Herzfeld, of Berlin, on the impressions gained during a recent visit to Cuba. Below will be found an abridged translation of it, which will doubtless prove of interest to our readers.

For the last three years (said Dr. Herzfeld) he had had a longing to visit Cuba and see for himself how the sugar industry was carried on. Hitherto he had never met with the opportunity of seeing the sugar cane growing. His desire was only increased when last year there appeared the now well known report of Consul Steinhardt, of Habana, which summed up with the question: "To what extent is the sugar production of Cuba capable of increase?" The answer given was: "If favourable circumstances continue, about six million tons."

Having recently occasion to journey to New York, Dr. Herzfeld seized the opportunity to pay a visit to Cuba. He could not, however,

*Or during the period of transition 26·048 grams in 100 Mohr's cubic centimetres.

go at the most favourable time, the middle of December to the middle of March, as his professional duties kept him at home till the 11th of the latter month.

His journey took him first to New York, as he wished to obtain some necessary recommendations. Thence he had the choice of two routes to Cuba; the overland one *viâ* Florida or the sea route to Santiago. Practical considerations pointed to the latter alternative. From Santiago he travelled by rail to Havana (869 km.). On his return journey he went by sea from Havana to New York, whilst his travelling companions preferred to go by land as far as possible.

Dr. Herzfeld received prior to starting some good advice from a former banker of Havana who lived in Berlin. On the supposition that many of his audience might desire to make a similar journey, he detailed the information he had received. Except that three day suits of the lightest material were necessary, one dressed in Cuban society much the same as in Paris or Berlin, for the nights are cool. One has to beware, above all things, of fevers; every Cuban has his own specific remedy for them, but to look after one's digestion is the principal point, for when it is out of order, it results, in many cases, in so sudden and violent an attack of fever that ere one or two hours are past, sometimes before the doctor can arrive, the patient's life is in danger. On the other hand, persons whose circulation is in order only succumb to the fever very gradually, and then a strong dose or two of quinine suffices to quell the attack.

Into the details of Dr. Herzfeld's voyage, interesting and amusing as they were, space forbids us to enter, and it will suffice to mention that he went by the Nord-Deutscher Lloyd from Bremen, and after a stormy passage reached New York a day late. Here he was met by Dr. Wiechmann, the well-known chief chemist of the American Sugar Refining Co., who gave him a warm welcome.

After a few days of sight-seeing in New York, Dr. Herzfeld left by steamer for Santiago, Cuba, where he was to arrive after a ten days' voyage. The steamer called en route at New Providence, the chief island of the Bahamas, where a number of English families disembarked. The principal town, Nassau, is known as a winter resort. The temperature of the place does not vary more than 19° or 22° C. all the year round, and the nights are never cold, so that substantial houses are not necessary. The water off the shore is so clear that the coral bottom can be distinctly seen far down.

Dr. Herzfeld's party went ashore for a few hours and visited the fruit gardens, where they regaled themselves with fresh oranges, cocoanuts, and grapefruits. The last-named is a fruit about three times the size of an orange, having a flavour compounded of orange, lemon, and grape juices. It is cut in two, sugar is sprinkled on the pulp, and then the contents are scooped out with a spoon. The

grapefruit threatens to supplant the orange in public favour. Plenty of them are sold in the United States of America and the United Kingdom, but so far none have been available for Continental markets.

Three or four days later, the travellers sighted Cuba; the harbour of Santiago was reached about four o'clock in the morning. This harbour is surrounded by high peaks, and the entrance is only 180 yards wide. Not far off is the place where the Merrimac was sunk by the Americans during the war. Traces of her are still to be found.

The first thing to arrive was the post, then came the quarantine boat; and finally at seven o'clock the passengers got ashore, as the steamer went into dock, a proceeding not always possible, since the owners of the lighters do not favour the laying up of a ship.

They had to wait an hour before the customs officer put in an appearance. When he did come, he simply chalked each box in a supercilious manner, and then they were free to leave and go into the gaily coloured town. A carriage took them to the Venus Hotel, where some fairly dear rooms were engaged—rooms they could not in the strict sense be called, for they had no glass windows, and one had to sleep almost in the open. The hall of the hotel was simply a verandah which could be protected by battens against the rain, but in general was quite innocent of shelter.

Having unpacked his things, Dr. Herzfeld hoped to be able to see a sugar factory that day (it was Saturday). So, as the places of business opened by eight o'clock, he went to call upon the German Consul, Herr Schumann, who gave him a hearty welcome. Dr. Herzfeld thereupon expressed the desire to see a small sugar factory to begin with, if possible that day. The Consul, however, explained that the roads were too bad to traverse, and they would have to depend on the railway; but the train left at six o'clock in the morning and there was none running at a later hour. The party would therefore have to wait until the following Monday. They were, however, given an introduction to the Santa Ana Usine, the place selected for their first visit.

They had now two days to while away, Saturday and Sunday. After going back to the hotel for some lunch, they went on a shopping expedition, and then found that they were badly provided for in one respect. They had expected to get on very well with their knowledge of English. But on going from one shop to another, they could not find in that town of 38,000 inhabitants a single shopman who understood English or French; everywhere only Spanish was spoken. In despair, Dr. Herzfeld bought an English-Spanish lexicon (he could not get a German-Spanish one), in which the phrases were obviously

on English lines. The party had therefore frequently much difficulty in making themselves understood, even when they rendered the words correctly, and as a last resort they had to show the words in the lexicon itself.

By now it was four o'clock, and, suddenly, the skies became overcast and it commenced to rain. Never in his life had Dr. Herzfeld seen such rain as fell that afternoon in Santiago. In ten minutes the streets were transformed into mountain torrents; it would have been impossible to go along them on foot, as the water would have been up to the knees. At the hotel the windows were battened in and the visitors sat gloomily in the dark. The mulatto who posed as interpreter assured them that it had been like this for eight days, each afternoon being marked by a heavy downpour, and that although it was not the rainy season. The younger members of the party wished to go to the theatre where Herr Schumann had promised to take them; but when the time arrived, word was sent that the performance could not take place on account of the rain. Everything appeared to be brought to a standstill when it rained. So they had to spend the time as best they could till they retired for the night. Mosquitos being abundant, the beds naturally had curtains round them. But the Cuban beds are peculiar in other respects too. As a means for helping to keep one's blood in circulation, the mattresses are provided with extraordinarily fine elastic feathers, such that when one attempts to turn over, one bounces into the air. Those unaccustomed to these beds, on moving in the night, wake up in a fright and imagine they are flying. For another thing, it gets suddenly very cold in the night time. At first on account of the heat one sleeps with little or nothing on by an open window. Then later on, the temperature falls considerably and the sleeper may easily get chilled. For this reason it is advisable always to have some warm covering at hand to put on when the cold begins to be felt.

Next morning, at half past six o'clock, Dr. Herzfeld woke up and observed from his window the method employed in Cuba for taking round the milk. No milk carts are employed; instead, the cow is driven to the customer's house, and after the milkman has ascertained how much milk is required, he proceeds to milk the cow on the spot to the requisite amount; then the animal is driven on to the next house. Fresh milk indeed! It being Sunday, the arrival of Herr Schumann was awaited, and then he was asked how the day could be spent. His answer was that nothing was done in Cuba in the day time, it being too hot; one waited till the cool of the evening. He, however, took them to see a Spanish club, where they drank cocktails and listened to a member playing the piano; next they paid a visit to the Cathedral, and spent some time at the service. This edifice is very richly finished, the seats being of real mahogany. Everywhere

in the clubs portraits of King Alphonso were visible ; but nothing suggesting the American liberation was noticeable. Dr. Herzfeld had already learnt from his Spanish fellow-voyagers how great is the hatred the Spaniard and the Cuban have for the American. Although he never could ascertain the real reason of this dislike, he had plenty of evidence that it existed and that there must be some definite reason for it. But the Cubans only laughed when they were asked about it, and the Americans pulled long faces; neither of them would suggest any real explanation. And yet the books, especially those published in English, were full of evidences of the benefits which the Americans have brought to Cuba.

At the club Dr. Herzfeld took the opportunity of inquiring whether it were true that the sugar production of Cuba would attain to six million tons. Herr Schumann replied that it was nonsense. "It will increase," he declared, "it will certainly increase, more or less rapidly, but how rapidly no one knows. I am in connection with nearly every sugar factory in the island, so am in a position to judge. Things do not progress over rapidly in this country." More detailed reasons he did not impart to Dr. Herzfeld. But it seems evident that the condition of the money market has much to do with it; ready money is dear and rates of interest high.

Some figures relating to Cuba are not out of place here. The population of Cuba according to the last census (1899) was 1,572,000, and last year was, as far as information goes, no more than 1,630,000. Of these, 172,000, or about 9%, are foreigners,* and 129,000 indigenous Spaniards.

Immigration is now almost confined to Spaniards, from whom at some future date trouble may be expected; for whereas under the Spanish régime only Spaniards were eligible for public offices, under the present rule only native-born Cubans may apply for them. This puts the Spaniards in the background, and as a consequence they go to add to the number of existing malcontents. Then there are 14,800

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* The number of foreigners in Cuba according to the census of 1899 was—

Spaniards	129,240
Chinese	14,963
African Negroes	12,953
Americans	6,444
Spanish-Americans	1,968
French	1,279
British	731
Italians	501
Germans	284
Other	4,272
Total Foreigners	172,535
Cubans	1,400,262
	1,572,797

Chinese. Formerly their number was 65,000, but the Chinese Government has for some time past forbidden their immigration. Besides, the American labour law is now in force, which forbids labour to enter under contract. Furthermore, there are 6,400 North Americans, 1,900 Spanish South Americans, 1,280 French, 731 British, 500 Italians, and only 284 Germans. Of unknown nationality, there are 4,500 persons. Thus of these 1,630,000 inhabitants, about 67% are whites.

Matrimonial relations are somewhat mixed in Cuba. Of the people who live together, only about one-third are married, the remaining two-thirds living in concubinage. 33% are coloured, and of the whites 51% cannot read or write, whilst 74% of the blacks are illiterate. It will hence be realised what difficulties were met with by the party in making drivers of vehicles understand where they were to go. The expedient of writing out the address was often useless, for the above reasons, and one had to try and hunt up a cabman who could grasp what was wanted.

Cuba is 44,000 square miles in area, or about as large as Bavaria and Würtemburg combined. It is instructive to compare it with Java. Java has an area of 49,000 square miles; and, while slightly larger, has a population of no less than 28 millions. Cuba has 36 inhabitants to the square mile, while Java has 570. These figures reveal how meagre the Cuban population really is, and how greatly it must increase if all the land is to be put under cultivation. In fact, a large part of the island is still virgin forest. Mountains appear on all sides and rise to heights of 8,000 feet. The rivers are short, the longest being the Cauto, in Province Santiago, which is 180 miles long. Earthquakes are of but rare occurrence. Some severe ones took place in 1776, 1842, and 1852, and wrought general havoc.

The minerals found in the island include gold, silver, iron, copper, manganese, lead, pitch, petroleum, naphtha, graphite, asbestos, zinc, and quicksilver. Coal mines exist, but are not worked at a profit. In Santiago de Cuba a few iron and copper mines are at work. Mining rights involve the payment of five dollars per hectare per annum.

To return to Dr. Herzfeld's diary, the party rose on Monday morning at five o'clock, and at six o'clock sharp were at the station. But their punctuality availed them nothing. In Cuba the trains run behind the published times, so that all the passengers may be in time. Moreover the train waited three-quarters of an hour while tickets were examined. Near the station was a charnel house with the inscription: "All passers-by are requested to uncover their heads, for this spot is sacred through the blood of patriots who were done to death here." This had reference to the affair of the *Virginius*, an

American steamer, which was seized off Jamaica in 1868 by a Spanish gunboat, and its papers pronounced forgeries. The crew were brought to Santiago, and on the first day three Americans and a Cuban were shot. The next day the Spaniards shot 37 more, including the captain, and on the third day the remaining ten men would have been executed, had not the British cruiser *Niobe* interfered and stopped any further murder. The affair almost resulted in a war between the U.S.A. and Spain, but matters were smoothed over by diplomacy.

The party took their places in the train, and it moved off at last. At first it appeared to be going at a startling speed, as the passengers were jolted about and could hardly keep their seats; but soon it was evident that it was the permanent way which was at fault, and not the train; the former was very roughly laid. At every stopping place banana plantations were to be seen, for in Cuba the banana takes the place of the potato at home. Far above these plantations were forests of palms waving in the sparkling sunshine. At length, at eight o'clock, the train stopped at a board on which was the name of the plantation they were bound for. Several negroes and negresses got out and proceeded along an avenue by the side of a swamp. Dr. Herzfeld thought to follow them, but only got into the bog, from which he was extricated with some difficulty. Any doubts as to which way to take were dispelled by the arrival of a negro leading a horse. He had come from the factory to meet the party, and through some misunderstanding had brought only one instead of four horses. The "Spanish scholar" of the party addressed the negro, but could not make himself understood. The question arose: who should bestride the horse? Naturally Dr. Herzfeld was chosen. The beast was a pretty wild one with fiery eyes, and hardly was he mounted when the animal commenced to prance round and round. The doctor called to his companions in German to come to his aid, but they were too much bent on getting out a camera and snap-shotting him to go to his rescue. The whole scene illustrated the drawbacks of being in a foreign country where one could not speak the language. Had Dr. Herzfeld been able to speak to the negro, he could have received prompt aid. The latter, however, did the best he could; he sprang away, and the horse and rider followed. The path was indescribably bad; there was no levelled track, and riding was the only feasible method of locomotion.

The doctor reached the factory first, and was followed in due course by his three companions on foot, one of whom had a couple of pounds' weight of loam adhering to him. They were invited to breakfast, which consisted of cold dried meat with garlic, dry cooked rice, hot meats, and milk and coffee. As to the Cuban coffee, it is first burned almost to an ash. A black muddy liquid is obtained therefrom, which is drunk with salted milk. In time one gets accustomed

to the taste and finds the concoction fairly palatable; but visitors do not stay long enough in the island for that.

After breakfast a visit was paid to the factory. Imagine a high open sided building with a very ancient roof, a paling all round further out, and a foundation with some machines on that seemed more suited for the scrap heap—and you have an old Cuban sugar factory. The most expensive apparatus were the pans and separators because they were made of copper. The place had also a railway connection. Its output was 30,000 large Cuban sacks; and the daily quantity during the campaign was about 20 to 30 sacks. The manufacture of sugar in Cuba is still carried out on primitive lines; none of the new processes, as adopted in Java, have yet been employed. The cane is first crushed in the mill, then the expressed juice flows along stone gutters (in which it easily starts fermenting) till it reaches the clarifiers and is tempered with 0·5% lime; the clear juice is then drawn off and boiled without any preliminary filtering. Only the final juices which are very thick are passed through primitive filters. The centrifugals were somewhat better; they were of the Weston suspended pattern. In Dr. Herzfeld's opinion, the latest Weston centrifugals, such as he saw in the United States, are in many respects superior to the Continental designs; the latter have got somewhat behind the times.

After inspecting the sugar factory, the rum distillery was next visited. On the way the military guard house was passed, where under a shed stood eight horses. These were troop horses used by the soldiers, told off to protect the factory from attacks and to keep the labourers in order. The planter was asked if he had to pay for the guard. He replied "No, not directly; but we pay well enough for them through our other taxes." This will be realised when it is stated that the mortgages on Cuban ground rents are not less than 58% of their total value; added to which there exist so called "mercedes," aggregating 14%, on the real estates, which are mortgaged obligations arising out of Church or State taxes, drawing interest at 5% and having first claim; the other mortgages are second ones and draw higher interest. The total liabilities are therefore about 72% of the value of the estates.

The visitors then returned to the house and partook of some lunch, after which they went off on horseback to inspect the canefields, the route extending through several ravines. After watching the cutting of the canes for some time, they rode back past the factory and came, to their surprise, to a deep gorge in which flowed a river, the existence of which they had not previously suspected. It was the Cauto, Cuba's largest river. It did not appear deep and several of the party wished to scramble across; but the guide observed that it would not be safe, as if the rain were to come on, the sudden rise of the river

would probably cut off their retreat; besides which, the water abounded with alligators. The last piece of information was enough to ensure a speedy return to the planter's house.

The visitors had arrived at eight o'clock in the morning, and the factory stopped working in the afternoon. It had probably worked longer than usual just to gratify the visitors, as the fields were wet from rain and the cane was consequently difficult to cut. But the first train back to Santiago did not leave till ten o'clock in the evening! They had, therefore, to force their company on the planter for the rest of the day. This is an awkward feature of travel in Cuba. Yet it is not without its advantages, for to pass the time the people are led to answer your questions more fully than would otherwise be the case. Dr. Herzfeld thus had an interesting conversation that afternoon with his host, in English, by the way. In fact his ignorance of Spanish confined his subsequent visiting to such places where English was known. This ignorance would not, however, have been felt so much if he had stayed longer in Cuba as there are some twenty factories in the island run by Americans; but he was restricted in his choice of routes.

Senor Auza gave Dr. Herzfeld some valuable information. Amongst other things he mentioned that a publication had lately appeared, *The Cuban Review and Bulletin (Sugar Number)*. It was really an advertising circular to induce capitalists to take up land in Cuba; but nevertheless it gave a useful list of all the Cuban sugar factories with particulars of their position and their proprietors.

Senor Auza asked for particulars regarding the profitable use of rum spirit; the planters are much concerned there how to use up the molasses; it is only worth one cent a gallon. Dr. Herzfeld advised that the spirit be employed for lighting purposes.

The evening came at length, and a wagon was got ready, although it was a somewhat risky proceeding to drive over the unbeaten track with two fiery steeds. Of course, it had commenced to rain punctually at 4 o'clock; but as good luck had it, the rain cleared off as they drove away to the station, and they reached their train in a dry condition. While waiting at the station, they saw lights, which they took to be the incoming train; but discovered it was caused by glow-worms and locusts, which emitted so strong a light as to be mistaken for lamps. In due course Santiago was reached, and thus ended their first day of sight-seeing.

(To be continued)

Some German sugar factories have been paying big dividends for 1904-05. Thus Nakel paid 20%; Demmin 10%; and Mescherm distributed 12%.

METHODS FOR THE CALCULATION OF EXTRACTION.

Adopted by the Hawaiian Sugar Chemists' Association, November, 1904.

As but few changes were made at the general meeting of the Association in 1904, in the methods agreed on in 1903, it was not deemed necessary to issue a new edition.

Correspondence received during this present season shows that the methods chosen were interpreted in many different ways, the main difference being in the interpretation of the term "cane."

Throughout the calculations given below, as well as those given in the methods of 1903, "cane" must be understood to mean the raw material in the condition in which it enters the mill.

Basis of Calculation.

The amount of sucrose coming to the mill in the cane is to be used as the basis of calculation; and this amount is found from the weight of the cane and the per cent. sucrose in the cane calculated by the following formula:

$$\frac{\text{Sucrose \% normal juice (100—fibre \% cane)}}{100}$$

Normal Juice.

Normal juice is the actual cane juice, and its composition is to be found as follows:—

Density.—The density of the normal juice is found by averaging the density of the juices from the different sets of rollers when no water is used for maceration. Such a test should be made once a week, and the factor

$$\frac{\text{Brix mixed juice} \times 100}{\text{Brix first mill juice}}$$

used for daily calculations.

Under "first mill juice" is to be understood the average of the juices expressed before the bagasse enters the second mill.

Purity.—The purity of the normal juice is found by averaging the purity of the mixed juice with that of the residual juice in the bagasse:

$$\frac{\text{Extr.} \times \text{purity mixed juice} + \text{(100—extr.) purity residual juice}}{100}$$

The purity of the residual juice should be determined in one sample of bagasse each day.

Sucrose: $\dfrac{\text{Brix normal juice} \times \text{purity normal juice}}{100}$

CANE.

Fibre.—Wherever the term "fibre" appears, it stands for the total insoluble solids.

In determining the fibre in the cane, the amount of field trash weighed with the cane should be determined once a day on one average car; the amount of fibre determined, and this added pro rata, to the amount of fibre found in the sample of clean cane.

Sucrose: The sucrose % cane is found according to the formula:

$$\frac{\text{Sucrose \% normal juice } (100\text{—fibre \% cane})}{100}$$

BAGASSE.

Sucrose: determined by aqueous diffusion

Soluble solids: $\dfrac{\text{Sucrose \% bagasse} \times 100}{\text{Purity of residual juice.}}$

Moisture: found by drying to constant weight at 100° C.
Fibre: found indirectly according to the formula:

$$100\text{—(moisture} + \text{soluble solids).}$$

EXTRACTION.

The term "extraction" is used to indicate that percentage of the sucrose in the cane, which is obtained in the mixed juice, expressed by the formula:

$$\frac{\text{Sucrose \% mixed juice} \times \text{lbs. mixed juice.}}{\text{Sucrose \% cane} \times \text{lbs. cane.}}$$

Where accurate weights are not available the extraction may be calculated according to the following formula:

$$\text{Bagasse \% cane} = \frac{\text{Fibre \% cane} \times 100}{\text{Fibre \% Bagasse.}}$$

$$\text{Sucrose in bagasse \% cane} = \frac{\text{Bagasse \% cane} \times \text{sucrose \% bagasse}}{100}$$

Extraction % cane = sucrose % cane—sucrose in bagasse % cane.

$$\text{Extraction \% sucrose in cane} = \frac{\text{Extraction \% cane} \times 100}{\text{Sucrose \% cane.}}$$

EXAMPLE.

Available data :—

First mill juice	= Brix	20·00
Mixed juice	= Brix	17·00
	Sucrose %	15·30
	Purity	90·0
Residual juice	= Purity	75
Extraction	= Approximately	93
Cane	= Fibre %	12·5
Bagasse	= Sucrose %	4·30
	Moisture %	45·0

Coefficient $= \dfrac{\text{Brix mixed juice}}{\text{Brix first mill juice}}$ .. .. 99·0

Normal juice:

Brix $= \dfrac{20{\cdot}00 \times 99{\cdot}0}{100} =$ 19·80

Purity $= \dfrac{(93 \times 90) + (7 \times 75)}{100} =$ 88·95

Sucrose % $= \dfrac{19{\cdot}80 \times 88{\cdot}95}{100} =$ 17·61

Cane: Sucrose % $= \dfrac{17{\cdot}61 \times (100-12{\cdot}5)}{100} =$ 15·41

Bagasse:

Soluble Solids % $= \dfrac{4{\cdot}30 \times 100}{75} =$ 5·73

Fibre % $= 100-(45{\cdot}0 + 5{\cdot}73) =$ 49·27

% Cane $= \dfrac{12{\cdot}5 \times 100}{49{\cdot}27} =$ 25·37

Sucrose in bagasse % cane $= \dfrac{25{\cdot}37 \times 4{\cdot}30}{100} =$ 1·09

Extraction % cane: $15{\cdot}41 - 1{\cdot}09 =$ 14·32

Extraction % sucrose in cane $= \dfrac{14{\cdot}32 \times 100}{15{\cdot}41} =$ 92·03

ERNEST E. HARTMANN, President.
EDMUND C. SHOREY, Sec.-Treas.

Honolulu, June 19th, 1905.

Mr. T. Hiraoka, manager of Messrs. Takata & Co., general merchants and importers, at Taihoku, Formosa, has enquired for catalogues and prices of sugar mills and sugar machinery.

MEMORANDUM ON THE PREPARATION, PACKING, AND TRANSMISSION OF SPECIMENS.

Mr. C. A. Barber of the Government Botanist's Office, Madras, has issued some useful instructions relating to the preparation, packing and transmission of specimens with a view to analysis. These instructions, being of general interest to planters all over the world, are given below.

HERBARIUM SPECIMENS OF DRIED PLANTS.

This includes all flowers, grasses, branches of forest trees, fruits, examples of economic plants such as indigos, fibre plants, pulses, cereals, and any specimens in which it is desired to study the form of the leaves, flowers, buds, &c., or when the scientific name is required.

The preparation of these is extremely simple. The main fact to be observed is that they will not travel safely unless perfectly dried, while, if dried, they can be posted or sent by train or even put aside for a while with perfect safety, always provided, in the latter case, that they are *kept* dry.

For the purposes of study it is important that the parts are spread out in such a manner that they may be readily studied when they reach their destination. It is of little use sending bundles of hay or branches of trees tied up into tight rolls in gunny bags or even carefully packed in boxes, as is too frequently the case. If the plants are spread out and pressed when still fresh and kept thus spread out until they are dry they will never lose their shape and will become useful permanent specimens.

Firstly, as to the parts to be collected. It is essential, among flowering plants, that the flowers should be sent on every possible occasion, since the whole of the classification depends upon the structure of the flower. Wherever available, fruits should also be sent, preferably still attached to the branch on which they grew. Leaves will of course be required and, in the smaller plants, especially grasses and ferns, the roots must be attached. Larger fruits may be dried separately, but it would be useful if the branch from which they had been picked was also sent.

It is, in fact, advisable that all the different parts of plants should be sent, so as to permit of their accurate classification. But it will frequently be possible to do a good deal without all the parts, and especially as the knowledge of the commoner forms increases. If information is required on any given plant, such parts as are available may be sent and an attempt will be made to deal with them, but a satisfactory answer cannot be guaranteed unless the flowers are present.

Then as to the preparation. The parts must be thoroughly dried. Where a desiccator of any kind is present, as an electric fan, sirocco or cardamom drying house, the work will be much easier. Otherwise the sun or even a good fire may be used. *The* important point to be held in view is that the quicker the drying, the more satisfactory will be the result all round.

The specimens should not be more than 18 inches long and 12 broad; a couple of pieces of thin board about this size should be provided and a large quantity of "drying paper." Various kinds of the latter may be employed, blotting paper, newspaper, brown paper, but the more porous and absorbent the paper is the better. The sheets of drying paper must be of the same size as the board and a neat package made of the boards with the paper between.

To commence operations, place one board on the ground and on it a wad of several sheets of drying paper: then carefully press out the plant, firmly and evenly, and quickly cover it with another wad of drying paper. The process may be repeated, alternating plants with drying paper, until all the specimens are in, when the other board may be placed on top and a heavy weight added or the bundle tied tightly with rope.

The specimens may remain in this position for 24 hours, after which they must be "changed." This consists merely in applying fresh drying paper to them. Each piece of paper which has been in actual contact with any plant must be taken out of the bundle and thoroughly aired. The changing must be done every 24 hours at least, and new dry paper added until all the moisture is extracted from the plant tissues. When a plant is properly dry it will, when held at the lowest part, stand up stiff and straight and its parts will be brittle.

Succulent plants or fleshy parts will, of course, require special treatment. These are not so easily dried as herbaceous specimens, and a certain amount of caution must be observed in applying pressure. But the main principles are the same and rapid drying is of more importance than ever. Various special methods have been suggested, such as momentarily immersing the part in spirit or boiling water and then spreading out to dry before putting in the paper, but this is not really necessary if constant changing is attended to. Large fruits may be dried separately in the sun or even before a fire and need not be placed in the press at all.

When all the specimens are dry, they may be placed between sheets of newspaper, so as to keep them separate, packed between boards and forwarded. On no account should the dried specimens be gummed or pasted on to sheets of paper. They must be quite loose so as to be readily examined on both sides. Another point to be kept in view is that there should be, where possible, at least four specimens of each plant sent.

In forwarding specimens, details must always be given as to the date and exact locality of collection, so that at any time more of the individual plant may be obtained if it prove of interest, and a permanent record may be kept which will be of use when working out the distribution of the plant.

Economic Products.

The sending of *economic specimens* such as seeds, tubers, chillies, plantains, cane sets, cocoanuts, gums, dyes, fibres, and so on will require a certain amount of thought, and no general rule can be given.

When the parts are dry or when drying will not injure them, they should be sent carefully packed, after first thoroughly drying. Moisture is the great enemy in close packages, and this must constantly be borne in mind. When living plants are being sent or such as are to be grown after arrival, this should still be thought of and all superfluous moisture removed, provided that the part is not in danger of being killed by drought *en route*.

Rapidity of travel should always be aimed at in the latter cases. The plants should not be taken out of the ground until the last moment, and they will be unpacked and dealt with as soon as they arrive.

For the rest, parcels post is an excellent mode of transit for all smaller dry objects, and, where there is little likelihood of their being damaged by rough treatment, small gunny or cotton bags will be found useful. Boxes must be employed when the articles are fragile or liable to be damaged by crushing.

The sender will, as a rule, have sufficient experience in this class of work to be trusted to forward the specimens so as to arrive in good condition. It should be borne in mind, however, that it is of little value to send things in too small quantities. For instance at least a dozen cholam heads of each kind should be sent, a pound weight of seed (unless it is costly), half a dozen yams or tubers of any kind, and so on.

It is partic· larly important in sending this class of specimen to forward at the same time the local information available concerning it. For this purpose, each specimen should have a number or distinctive mark attached to it which is used in correspondence. Care should be taken to give the exact date of collection, the locality and vernacular names used locally; if worthy of note, the mode of cultivation, local value and uses should be added, together with any other matter of agricultural importance.

Diseased Plants.

When a plant or crop is diseased and it is desired to know what is the matter and whether any treatment can be economically applied, the subject becomes much more difficult. Sometimes an insect pest

is very evidently at the bottom of the trouble and special rules will be given for this class of pest, but in other and indeed the majority of cases it needs some training to judge what is the cause of disease. In these cases it will be much the best plan to write for instructions in each particular case. The method sometimes employed of digging up a plant, root and branch, and forwarding it by rail or otherwise in a gunny bag or bamboo basket, is not to be recommended. It may succeed in certain cases, but the mass of mouldiness which arrives at the journey's end is not in a fit condition for examination under the microscope, and there have been instances when the secondary decay fungi arising have been made responsible for the disease, much to the obscuring of the point at issue.

In all cases it is advisable to make a careful *local* study of all parts of the plant, including the roots. Anything unusual should be noted, especially the presence of caterpillars or insects or any outgrowth or excrescence which looks like a mould or fungus. A herbarium specimen must be prepared according to the rules already laid down, choosing of course especially such parts of the plant as are most affected. With the dried specimen should be sent notes as to the exact state of affairs and, preferably, some statement of the amount of injury being caused. Instructions can then be sent indicating the parts required and the medium in which they are to be sent.

As a general rule, where the pest is of a fungoid nature, it will be found advisable later to forward parts attacked in spirit for microscopic examination, since dried plants are not suited for this purpose. Most spirits will serve, but anything that corresponds most with rectified or methylated will be best.

Where, on examination, an insect appears to be doing the damage, it becomes important to learn as soon as possible what this insect is. This must accordingly be sent as well as the dried specimen of the plant attacked. But there are certain rules to be observed.

Considering their perishable nature, it is essential in all cases that a considerable number of specimens should be sent,—at least a dozen and, if possible, in all stages.

Grubs or soft-bodied insects, such as Aphides, Thrips, Plant-lice, and also flies, may be sent in dilute spirit, and, when occurring internally, they should be sent *in situ* in the plant tissues.

Plants affected by scale insects (plant-lice which are hard and scaly or white and woolly) should be dried and forwarded in little paper packages. When leaves are being sent they may be first pressed, but this is not necessary.

Hard-bodied insects, such as beetles, grasshoppers, &c., may be first killed and then sent dry in sawdust which has the finer particles sifted out. It is advisable in such cases to insert napthalene or a piece of paper or cotton wool soaked in carbolic acid, the latter not touching the specimen.

Butterflies and moths should be carefully killed either in a "killing bottle," or by squeezing the body sharply below the insertion of the wings, the wings then folded back to back and the specimen placed in a little envelope of paper. It is important in the latter case to touch and thus injure the delicate wings as little as possible and also to keep the legs and antennæ intact.

The "killing bottle" is the best means of killing the specimens to be sent dry. This is an ordinary tight-fitting bottle with a layer of plaster of Paris and potassium cyanide at the bottom. It becomes filled with hydrocyanic acid gas which is deadly to insect life. In its absence, a drop of chloroform, either in a bottle or not, is extremely useful especially for moths and butterflies, where rapid death is desirable. Also the fumes of strong ammonia can be made use of and will kill almost at once. Beetles may be dropped for a moment into spirit or even boiling water, but they must be most thoroughly dried afterwards, and the method is to be avoided where possible.

These are the main principles regarding the preparing of insect specimens, but there will be many cases where it would be wise to drop a line first for instructions as to how to deal with a particular pest, always accompanying it with a pressed specimen of the plant affected.

For instance, there is so much likeness between the grubs and caterpillars of the different families that it is usually necessary to obtain the perfect insect before any determination can be made. In many pests the grub or caterpillar alone is to be found. It will then be necessary to send it, in quantity, alive to the laboratory, so that it may be reared and the perfect insect obtained.

When sending pests alive, several important points must be attended to. If the insect is in the feeding stage it must be supplied with food for the journey, some of the leaves or stalks on which it is found being placed in the package for that purpose. Again, the contents must be so arranged that they do not shake about in the post, and as leaves shrivel quickly they must be fairly tightly packed, or pieces of crumpled tissue paper used for filling up.

Any excess of moisture must be avoided and plenty of air must be available. This will be best effected by making small holes in the box in which the specimens are to travel and plugging them with cotton wool. Unless the latter precaution is taken the contents are only too likely to be eaten by ants on the journey.

Finally, insects living in the earth should be packed in earth which must fill the box and which should be in the same condition as regards moisture as in nature. It is obvious that anything like oiled paper or waxed cloth must not be used for these packages since the air and moisture cannot pass. Ordinary brown paper will be found to be sufficiently porous for this purpose.

C. A. Barber.

PORTUGUESE EAST AFRICA.

The Inhambane Sugar Industry.

Last year as the result of a visit paid to Inhambane, Messrs. Donaldson & Sievwright, of Delagoa Bay, purchased for a company they were forming a property on the Mutambo River, which had belonged to a Mr. J. F. Rosa, and had been worked on a small scale as a sugar estate, the crop being 75 hectares of cane per campaign. This property, which is freehold and 2100 hectares (5187 acres) in extent, was bought for £12,000. The sellers were given the choice of taking cash or shares, and they choose the latter, inasmuch as they had every confidence in the venture. The Company, the Inhambane Sugar Estates Ltd., decided to issue a capital of 5000 fully paid £1 shares, and a further 5000 were kept in reserve. The local Portuguese merchants being convinced of the soundness of the venture bought up most of the first shares at 22s. 6d. The company then ordered new sugar machinery from Glasgow. Messrs. the Mirrlees Watson Co. secured the contract, and they sent out an engineer to supervise the erection and starting of the plant.

It consisted of a very heavy 20 in. × 36 in. three-roller mill, with megass elevator taking the green megass and delivering it to the furnaces of two multitubular boilers. The arrangements of the factory are such that the juice is pumped from the mill to a sulphur box placed in the roof of the building: from this it gravitates to four steam clarifiers, where it is cracked and cleaned, the clear juice running either to a defecator or through bag filters direct to the triple effect supply tank.

The triple effect vessels are 3 ft. 3 in. in diameter, and contain 700 sq. ft. of heating surface. The syrup from the triple effect is led to the vacuum pan supply tank, and from there drawn into a vacuum pan which is designed to strike 1½ tons of dry sugar, the vacuum pan and triple effect being connected with a double connecting rod vacuum pump. The first sugars are struck from the vacuum pan into a receiver over the centrifugals and cured hot in two Weston's Centrifugals.

The scum and bottoms from clarifiers and defecators gravitate to a scum blow-up, and are forced through the filter press by montejus, the clear juice being forced up to the defecators, where it is cleaned before mixing with the clear juice. The whole factory is commanded by a water tank placed on a high tower.

From consideration of the foregoing it will be seen that this factory is thoroughly well equipped, and might with advantage be copied in many countries where only the commonest of muscovado sugars is made at the present time.

The plantation of 75 hectares has been supplemented by the preparation of a further 150 hectares, of which nearly a hundred are already planted with cane. An electric light installation has been erected, and

three miles of tramway have been laid down. Many small planters in the neighbourhood will in future send their canes to this mill.

The estate is alongside the tidal river Mutambo. While being above the highest point to which the salt water reaches, it is yet so situated that the rising tide banks up the fresh water, and at the spring tides this is allowed to overflow into irrigation ditches and spread over the cane fields. The river is also available to transport sugar to the coast, the cost being about 10s. per ton from factory to f.o.b. Delagoa. Some 500 or more families are settled on the estate, and as many as 900 labourers have been at work at one time. The pay is about 7s. per month.

The factory output is estimated at 4 tons of white sugar, and for local requirements it gets a rebate of 75% of the duty, so that it is protected against foreign competition to the extent of about 8s. per cwt.

"CLARINE":

A New Clarifier and Decoloriser for Sugar Solutions.

By SIGMUND STEIN, Sugar Expert, Liverpool.

Messrs. John Poynter, Son & Macdonalds, of 72, Great Clyde Street, Glasgow, have sent me samples of their new clarifier and decoloriser, "Clarine."

I have tried this agent with many sugar solutions and sugar liquors, with beet sugar, cane sugar, maple sugar, beet syrups, cane syrups, maple syrups, sweet waters, molasses, &c., and I have found it a very eminent clarifier, the like of which I have so far never experienced.

The sample of "Clarine" sent me by the above firm is in the form of a black powder similar to charcoal. It acts instantly in a sugar solution of a density of 28° to 30° Bé. It has a very good effect in a solution having a temperature of about 170° F. The clarification should be made in a neutral sugar solution, as "Clarine" then acts the best. I have found that 1% of "Clarine" on the weight of dry sugar in the sugar solution is sufficient to clarify the cloudiest liquor. The precipitate formed by the "Clarine" settles quickly down and facilitates the filtration. The filtration when using this clarifier goes on very rapidly, and a bright sparkling sugar solution results.

Messrs. John Poynter, Son & Macdonalds sent me some samples to America during my visit there, and I then made numerous experiments with cane sugars, and cane sugar solutions and cane molasses. I may state that I have been perfectly satisfied with the results both as regards clarification and decolorisation; and in a subsequent number of this Journal I hope to be able to supply some detailed account of my experiments with this new reagent.

THE SAMALKOT EXPERIMENTAL FARM, MADRAS.

SEASON 1903-1904.*

The area under sugar cane during the year 1903-04 was about eight acres as compared with five during the previous season. All the 1902-03 plots, with the exception of the *manurials*, were allowed to grow as ratoons. The weather conditions were very favourable to the growth of canes in the Godavari delta, and there was abundant rainfall. The last watering before the canals were closed was on April 25th, and the first watering after their re-opening on May 5th. During this interval the canes have to get along each year as best as they can. There was little disease generally in the district, and the season was regarded all round as a successful one.

The experiments were divided into three classes, which were termed for want of better names *Varietal Plots*, where different kinds of cane were grown and compared; *Methods Plots*, where selected local canes were planted in different ways or received different cultural treatment; and *Manurial Plots*, where various manures were supplied to them. The plots were planted in duplicate so as to rule out as much as possible the accidental differences in soil which were known to exist, and greater uniformity was introduced at the same time in that all the plots were one-tenth of an acre in extent, and they were so arranged with wide interspaces between that they could be readily examined at different periods of growth.

The canes were reaped in February and March, the ratoons being dealt with in the former month. Three mills were erected and were kept going night and day.

The *varieties* grown were Vansi (from Bombay), Yerra, White Mauritius (from Bombay), Bonta, Sanna Bile (from Bombay), Hospet (from Bellary), Namalu, Red Mauritius (from Bombay), Valu, Pandia (from Bombay), Cumbum (the striped cane of Cumbum), Keli, Mogali, Seema, besides a few rows of four years' acclimatised Mauritius varieties presented to the farm by the Collector of Vizianagram.

Whereas in 1902-1903 the local varieties had been obtained from the neighbouring fields and were doubtless diseased, and the exotic forms had long distances to travel and were thus in poor condition when planted, the seed cane of 1903-1904 was raised from canes grown on the farm and carefully selected. This alone would account for the much more healthy and successful stand of canes produced on the farm in the latter year. But disease was still observable in

* Abridged from *Bulletin 51, Department of Land Records and Agriculture, Madras, by C. A. Barber, Government Botanist.*

several of the local varieties, and it is probable that it will take some years before these can be granted a clean bill of health.

The Red Mauritius lead easily both in the weight of canes per acre and in the yield of jaggery; it was a good even stand, and in this respect had a great advantage over several of the others which might have rivalled it. The average yield of the twelve kinds was nearly four tons of jaggery per acre, a very promising result. The Red Mauritius produced 4·7 tons of jaggery and nearly 50 tons of canes.

The *Manurial Experiments* were, for the reason already given, limited to the comparative trial of local products within the reach of the ryots. The known unevenness rendered an extensive scheme inadvisable, but at the same time, partly for the sake of practice, it was thought worth while to carry out a few simple experiments in duplicate. The following manures were used: *Castor Cake*, the main sugar cane manure of the district, which might be used as a standard; *Bone-char*, a waste product of the local Deccan Factory, where it could be obtained at a fairly cheap rate and whose content of phosphoric acid was satisfactory; *Lime*, which, while in reality used to test its mechanical action on the condition on the soil, was conveniently included here; *Compost*, made at the farm, a product which can be readily obtained by the ryots themselves, but whose content of nitrogen on the farm where there were no cattle was very low, and which should therefore be rather regarded as a mechanical manure.

The yield in the "no manure" plots was very poor in both cases, and this was an encouraging feature. These plots were well below the rest. The addition of Compost was attended with good results, indicating perhaps that the soil is naturally rich and that mere attention to its physical condition may in certain cases yield fair crops. The Castor Plots were unfortunately very unequal, one plot producing just double the amount of jaggery obtained from the other. The canes from start to finish were very poor in the latter. The addition of Bone-char, according to the results, was a success. The following is the order of yields: Bone and Castor, Castor, Lime and Castor, Compost, and, a long way behind, no manure.

The *Methods Plots* were grown on a block of land similar to that on which the varieties were planted. There were the same unaccountable differences in the plots and the same weak places where irrigation was difficult. The growth on the whole was, however, good.

Some of the plots suffered from various causes which would naturally discount the value of merely judging by the cropping results. Thus the Bonta canes were entirely eaten out by jackals, which prefer the softer canes.

As the Bonta came out well in the 1902-3 season, it was selected for the 1903-4 experiments in company with the Yerra, a cane which had some claims to immunity from fungoid disease. But while the Yerra succeeded to admiration, it overshadowed the smaller Bonta, and the latter was moreover attacked by jackals, thus proving a failure. The next experiments will be almost confined to the Yerra cane; but the following season may see a trial given to the Red Mauritius, as it is likely to become widespread, and it will be important to know its reaction to various treatment in order to suitably advise the ryot in its cultivation.

The *country system of planting* the canes is by distributing them more or less evenly over the the ploughed and puddled land by treading them in. The sets are thus buried to the depth of 1—2 inches. But in cases where the ploughing has been incomplete they are frequently seen protruding after planting. This is generally fatal and the system fails in this respect. The number planted is about 25,000 to the acre. This is considered excessive. The Varietal plots last year were planted at the uniform rate of 15,000 to the acre, and the results were satisfactory.

An improvement has been introduced in the method of *weeding and hoeing*. This, as is well known, is one of the principal expenses of cultivation. The only instrument in use in the Gódávari delta is the *tolika*, a small, straight, chisel-like hoe. It is the custom for the coolies to form in line, work the ground in front of them in a squatting position, and move forwards until the field has been traversed. This plan of moving forwards is necessary where the plants are irregularly scattered, as otherwise they would tread on the young plants and do much damage. By planting the sets in rows, however, the *tolika* has been successfully used backwards. It is interesting to note the difference of the plots worked in these two ways after the hoeing is completed. In the country system the ground is trodden under foot and half the benefit is lost, whereas in the other case there is not a footmark upon the ground and the whole field presents a singularly well-forked appearance. The cost of working is the same in the two cases. The growing of the canes in lines has a further advantage in that the labourers are in the habit of walking along the trenches between the canes and thus the beds between do not get trodden on, whereas in the scattered planting the path is across the beds, a matter of considerable importance all through the life of the plant.

The planting of the sets according to the *West Indian system*, known as "holing," has been discontinued. The soil in those islands has been brought to such a perfect mechanical condition that to make a "hole" merely requires four or five rapid movements of the negro's hoe. Here to produce the same would need a crowbar and much

really heavy work, for to do it in puddle would be obviously impossible. Until the soil is in a like friable condition the labour involved will be quite out of proportion to any possible advantage.

The experiments with *liming the ground* have led to no definite result. While the experiment was tried in the Manurial plot in order to obtain exact figures, it was also introduced in the Methods plots in company with trash-burying and distant planting. The conclusion at present drawn is that the addition of lime improves the texture of the soil, but it is too slow in its action to produce the effect desired during the life of the canes. At any rate, although the soil is in good condition at the end of the year, there has at present been no very appreciable difference in the yield of canes.

Certain plots were treated with *buried trash*. The dead leaves of the cane plant were collected and buried in the ground where the sugar cane was being planted. Burying the trash is a universal custom among the West Indian planters, and to it chiefly is the extraordinary friability of their soil due. It may be noted also that the cane is planted almost continuously on the land and that there is no alternation with paddy. Irrigation is unknown in the islands, the plantations depending upon rain. In the Gódávari district the trash is never buried. It is used as fuel, for damming up the water channels, and for various other purposes. If any is over, it is burnt upon the fields. This appears to be a great waste of a valuable substance. Not only has the trash the effect of lightening the soil, but it contains many of the constituents of the cane plant itself in an available form.

Some attention has been devoted to an experiment commenced last year whereby the trash was not buried immediately, but first *used as a mulch*, and only buried after the reopening of the canals. This is a variation on the above experiment. It will at once be seen that it has an important bearing on the whole question of weeding and hoeing. The advantages which are claimed for the method are (1) that the ground is kept covered from the sun's rays during the hottest part of the year, when the young plants are striving to get a foot-hold, (2) weeds are kept back and thus the expensive *tolika* and even the rake work are largely dispensed with, (3) after irrigation the surface is kept moist and in a friable condition, since it is protected from the brickmaking influence of the sun, (4) when the canals are reopened and the canes are beginning to cover the ground, it is dug in and acts as a manure and a mechanical agent for lightening the soil. It must be remembered, in passing judgment on this experiment, that the conditions of the Gódávari delta are peculiar. The cane sets are put in as the weather begins to get hot and the air dry. There is usually no rain for some months after the sets are planted. Added to this, when the plants have barely obtained a

root-hold, the canals are closed for their annual cleaning, and the young and struggling shoots have to encounter a severe drought for about six weeks, when no water can possibly be given them. Last year there was a seasonable rain of nearly three inches in the middle of this period of enforced drought, but this was unusual. The year before, there was not only no rain during the canal closing time, but, when they were reopened, the rush of water in the canal was so great that it burst the banks high up, and there was not a drop of water for the plants for another month, altogether ten weeks without water. Naturally, many of the plantations were wiped out, and others lost half their plants. The need for some plan of conserving the moisture in the soil and warding off the dry heat of the sun in April and May was thus felt early in the history of the farm, and the present experiment is an attempt to effect an insurance against its recurrence.

The canes in the Gódávari district are very high in their growth. In the varietal plots this year there were over half a dozen kinds where the canes were over 20 ft. high. This may be partly due to wrapping itself, but whether this is so or not they certainly need support. This is given by twisting the older leaves while still half green and wrapping them round bamboos fixed in the ground.

The *question of ratoons* is an important one and not so simple as at first appears. When the canes are ratooned, or grown a second year from the same roots, any fungus disease that they may be suffering from is usually intensified. This is so with the Red Smut induced by *Collectotrichum falcatum*. But ratooning is a useful proceeding and cannot be left out of account in an economic study of cane cultivation. The yield is not so great as in plant canes (as the first year's crop is called), but the expenses are very much less. There are other facts to be considered. The ratoons are usually an eleven months' crop, whereas the plant canes require a full year to mature. The ratoons are thus reaped earlier, and, since it is an advantage to plant as early as possible in the season, they are frequently used for planting the next year's crop. And this using of ratoons for seed has not improbably had a good deal to do with the spread of disease over the district. The 1902-3 varietals, planted from such seed as could be obtained locally from the ryots, while giving fair results as plant canes, were in most cases badly diseased as ratoons in 1903-4 and had to be rejected for seed purposes. On the other hand, if a field is healthy, it will probably be well worth while to ratoon it. And there does not seem to be any intrinsic objection in the Gódávari conditions to ratooning for more than one year. Reference may be made to a field in the island of Dominica examined in 1893 which was planted in 1859. The conditions were peculiar in that the plantation was situated on the banks of a river which annually overflowed its banks and deposited a layer of silt.

The *distances* at which the canes may be planted from each other has received careful attention. The conclusion arrived at is that no general rule can be laid down in the matter, in that the canes differ considerably in this respect. The rate of planting this year has been 10,000 to the acre, and it is hoped thus to detect at once the plants with a natural tendency to tillering. A comparative experiment is also being tried with 10,000, 20,000 and 30,000 sets per acre. The matter cannot be settled off-hand and some years of consecutive experiments will be needed.

During the current year a very large consignment of Java jaggery of great purity was imported by the Deccan factory, and it was thought that this was a remarkable comment on the local manufacture. It appears that, from its large percentage of glucose, the Gódávari jaggery is useless from the refiner's point of view. If an export trade is to be built up, and it is only in this way that the area under sugar cane can be very largely increased, it seems necessary to improve the quality of the raw material. This can easily be done by appropriate precautions in the boiling of the juice. These were accordingly taken under the direction of Messrs. Parry & Co.'s Chemist, and a very large number of cakes were made at the farm according to both the improved method and the local custom, and the resulting jaggery analysed. We have thus obtained a fairly complete knowledge of the jaggery producing properties of the varieties grown upon the station. And we have a good idea of which in particular are best fitted for turning out a good refining jaggery.

The result of the experiment has not, however, been very encouraging. The conclusions drawn from the previous year's crop experiment have been verified. The price which Messrs. Parry & Co. could pay for the improved cakes was considerably lower than the price of the inferior product in the bazaar, whereas the specially prepared jaggery was quite unsaleable in the local market. It is thus hopeless to expect the ryots to prepare their jaggery according to the method which will make it available for refiners. Another plan is to be tested during the ensuing season, in fact one based upon the West Indian mode of preparing "hogshead" sugar. The prospects are more hopeful in that the product is not objected to locally, while of good refining quality. A report on this subject will be submitted in due course.

A gold medal has been awarded to the Sack Filling and Sewing Machine Syndicate, Ltd., of 89, Chiswell Street, E.C., for the machines for filling and sewing sacks exhibited at the Colonial and Indian Exhibition at the Crystal Palace.

GERMANY.

Dantzig.—The year 1904 was a remarkably good one for those concerned in the sugar trade. At the end of 1903, prices being very low, the manufacturers were able to make very advantageous contracts with the farmers, or growers of beet. Prices remained low during the beginning of 1904; but later on, when it became known that stocks were lower than had been expected, an extraordinary rise of nearly 100 per cent. took place, the price going up from 7 marks 50 pf. (or 7s. 6d.) to 14 marks 50 pf. (or 14s. 6d.) per cwt. This, of course, brought prosperity to all who had not sold before the rise took place. The factories were able to pay large dividends, and the important sugar refinery at Neufahrwasser, rebuilt after being burnt down in 1901, resumed work in December under very favourable conditions. The new establishment is adapted for an annual output of 60,000 tons. The exports of sugar of all kinds from Dantzig during the year were:—

To	Quantity. Cwt.
United Kingdom	807,328
Denmark	60,264
Netherlands and Belgium	515,740
Norway	72,554
Russia and Finland	176,402
Sweden	49,671
German ports	265,525
Total	1,947,484

The exports to China, Japan and to Canada, which have figured in former lists, appear to have ceased.

The Consular Report on the Finances of Germany contains the following note on the sugar tax:—"Up to 1903 the sugar tax was levied at the rate of about 10s. per cwt. (20 marks per 100 kilos.) of the sugar placed on the market, with a progressive surtax on the total amount produced in each factory. Since the abolition of bounties in consequence of the Brussels Convention of March 5, 1902 (which came into force on September 1, 1903), this surtax has been repealed, and the rate of the sugar tax fixed at about 7s. per cwt. (14 marks per 100 kilos.). This change coincided with the collapse of the Sugar Syndicate, which had for some time kept prices at an artificially high level, thus restricting consumption and consequently the yield of the tax. The latter amounted in 1903 to £4,988,252, an increase of £183,024 on the preceding year; it was estimated for 1904 at

£5,645,012, but before the end of that financial year it had already exceeded the estimate by £1,500,000, so that it was thought justifiable to fix the estimate for 1905 at £6,363,500. It is now admitted that the cheapening of sugar in consequence of the reduction of the tax and the abolition of bounties has resulted in a quite unexpected increase of consumption, to which this rise in the yield of the tax is due.

Mexico.

The yearly sugar report for 1904-05, published by the "Hacendado Mexicano" has the following:—

"Sugar plantations have existed in this country for hundreds of years, and they have in nearly all instances been operated on a paying basis, although the methods of handling the cane and its manufacture have often been crude and wasteful in the extreme. The power for the primitive mills was furnished by mules or oxen, and later on small three-roll mills operated by steam power were introduced.

"In a great number of the plantations of Mexico to-day the cane is ground by these old-fashioned three-roll mills, although they are not sufficient to extract anything like the full percentage of saccharine matter that may be taken from the cane. . . . ."

In the majority of cases, also, old methods are in vogue for the transportation of the cane to the mill, and for the handling of the bagasse, or ground cane, after it has passed through the mill. These methods are at the same time relatively much more expensive than the modern way.

The cane is brought in either on the backs of natives or in ox carts, and the bagasse requires a large force of peon labourers to carry it out of the mill and spread it on the ground to dry, whence a few days later it must be carried back into the sugar-house and thrown into the furnace to burn. The sugar turned out by these mills is not of a very high grade.

Vast improvements have been made in recent years in labour-saving sugar machinery, and a considerable quantity is now finding its way into Mexico. Immense 12-roller mills are now being planned that have two additional rolls, called "crushers," through which the cane is first passed, and when afterwards it has gone through the four sets of three rolls each, very little saccharine matter is left in the cane. The dry bagasse is conveyed on an automatic carrier directly to the furnace, furnishing in a large mill practically all the fuel that is required to operate the factory.

The methods of transferring the cane from the fields to the mills have also been revolutionised, tramways being laid through the fields and the cane piled upon the cars, which are drawn to the mills by steam locomotives.

On arrival at the mills it is taken from the cars by a cane unloader by which it is placed on the cane carrier, whereby it is run upward and forward until it reaches the crusher. This consists of two rollers having zigzag teeth or grooves which work into each other, drawing in the cane, partially crushing and cutting it up into about 6-inch lengths. After passing through the crusher, the mat of cane passes down an iron apron into the first three-roll mill, where it is crushed under hydraulic pressure on the top roller of 250 tons.

After passing through this mill, the cane, having first been sponged with hot water, is carried to the second three-roller mill, operating under a pressure of 320 tons on the top roller. It is then sprayed again and passes to the third mill, operated under a pressure of 400 tons on the top roller, and later it goes to the fourth if there is a fourth, which is not the case so far in Mexico, and in this event the top pressure is nearly 500 tons. The cane refuse, or bagasse, is carried by an automatic conveyor to the furnace feeders, whence it is dumped into the furnace as needed. The juice expressed from the cane is conveyed to an automatic screen apparatus, filled with fine holes, through which it drains into an immense receiving tank, whence it is pumped up to a juice weighing machine situated over the liming tanks on a level with the vacuum pans. It is then weighed and dropped into the liming tanks to be clarified.

Later, the juice is discharged into settling tanks, and sufficient time being allowed for impurities to settle out, the clear juice is drawn off into a receiving tank for juice filters. The settlings are diluted with lime and re-agents, and pass to the filter presses by means of which all solids are separated from the clear juice, which is then discharged into the receiving tank over the evaporator.

The modern sugar mill is usually constructed of steel, and is of a very substantial character. Many miles of tramway lines are laid through the cane field, and there is required an equipment of several hundred cars, as well as a number of steam locomotives.

All these improvements have made it possible to dispense with hundreds of labourers, and have not only increased the sugar product, but have reduced in like or greater proportion the expense of handling and manufacturing it.

In Mexico, even with the old-fashioned and expensive methods, the sugar planters have formed one of the wealthiest classes of citizens, and with the incoming of the vast perfected labour-saving machinery, there can be no question that Mexico will loom large in the destinies of the world's sugar production.

Mr. Hedemann has been studying the ground and making the plans for the building of a 1000-ton mill, to be erected on the Oaxaqueña plantation of the Isthmus of Tehuantepec, the property of the Tabasco Plantation Company, which will be the largest by far of any in the Republic of Mexico.

Comparison of Production of Sugar in the Republic of Mexico during the last Five Years.

Production in	Quantity.
1899-1900	75,000
1900-01	95,000
1901-02	103,000
1902-03	112,000
1903-04	107,000
1904-05*	115,000

As will be seen by this statement there has been a shortage in the production of 1903-04 on that of 1902-03 of about 5,000 tons, due to the fact that in the state of Morelos there was a shortage of about 4,000 tons and in Oaxaca about 2,000 tons, but on the other hand Puebla increased 1,000 tons. It is feared that owing to the continual rains which have fallen during the whole of the latter part of 1904, and also during the first part of 1905, this crop will also be a short one, although, owing to the high prices obtained in foreign markets, much more raw sugar is made, which of course will increase the output of sugar, decreasing the amount of molasses, and financial results will be better, although the quantity produced may not be as great as expected. The estimate for this year's crop, that is 1904-05, is put down at 115,000 tons.

Much of the sugar from the State of Morelos has been exported to the United Kingdom, and Morelos sugar fetches a good price in the local market, from 13 to 13½ r. per arroba (3s. per 25 lbs.). It is expected that there will be a rise in the price as stocks are very low.

Porto Rico.

Ponce.—The Vice-Consul reports:—The sugar crop was only fair, but larger than the previous year; 33,738 tons were exported, and about 5,000 tons used for local and island consumption. Export value was £469,195, against £347,000 in 1903.

No statement has been published by the Guanica Centrale sugar factory, which is the largest in the island.

According to the annual report of the Central Aguirre the result was satisfactory, and although the average price at which the crop was sold was only 13s. 9d. per 100 lbs., a net earning of £51,800 was obtained, giving a dividend of £26,700, or about 6·67 per cent. on a capital of £400,000.

The crop of this factory was taken off in 131 working days, at an average run per day of 20½ hours, the average amount of cane per day was 1,216 tons, average extraction of juice was 80·43 per cent. of the total weight of cane.

The production of sugar for the crop was 33,742,982 lbs., of which 33,116,148 lbs., or 98 per cent., were first sugar, and 626,834 lbs. molasses sugar.

* Estimated.

These sugars are not included in the exports of Ponce, as they are shipped direct from the harbour of Puerto-Jobo, where the works are situated.

They have under cultivation for next year about 7,500 acres of cane, and expect a yield of about 20,000 tons.

A French company under the name of "Compagnie des Sucreries de Porto Rico," with headquarters in Paris, has been incorporated with a capital of about £180,000.

They have bought five plantations in this district, in all about 2,500 acres, and have built up a central factory which they call "Central Fortuna."

The factory is situated about five miles from Ponce. The capacity of the mills is about 600 tons of cane per 24 hours. The novelty about this factory is that they are putting up a new system of diffusion of bagasse, which it is asserted will increase the extraction from canes fully 2 per cent.

This is the first time that this system of diffusion has been undertaken on a large scale, the inventor himself, a French chemist by name H. Manoury, being the general director of the central factory and of the Compagnie des Sucreries de Porto Rico in this city. The first crop under this new system will be taken off next year.

Molasses continue decreasing in this district, as less muscovado sugars are being made.

The exports were:—1904, £50,783; 1903, £45,344.

The increase in value is due to higher prices during the year, as only 1,432,587 gallons were exported, against 1,685,262 gallons in 1903.

MONTHLY LIST OF PATENTS.

Communicated by Mr. W. P. Thompson, C.E., F.C.S., M.I.M.E., Chartered Patent Agent, 6, Lord Street, Liverpool; and 322, High Holborn, London.

ENGLISH.—Applications.

14662. J. E. M. Vincent and K. Gengnagel, Oxon. (Communicated by R. J. L. Witty, Australia.) *Improvements in the production of saccharine cattle food from molasses and sugar syrups, mainly with respect to the materials employed therein.* 17th July, 1905.

15023. K. K. Balthasser-Weygang, Strood, Kent. *A new or improved process for producing foodstuffs, glycerine and saccharine-like substances, and other products.* 21st July, 1905.

16269. D. Stewart & Co. (1902), Ltd., and T. Wishart, London. *Improvements in evaporators for sugar and the like.* 10th August, 1905.

GERMAN.—Abridgments.

161448. Emil Passburg, of Berlin. November 16th, 1904. *A method of drying rapidly setting fluid and pasty substances in vacuum*

driers having a revolubly heated drying drum immersed in the drying fluid. This drying drum, which is immersed in the drying fluid and is heated and revolved for drying rapidly setting fluid or pasty masses, is characterised by the fluid being constantly agitated over the bottom of the drying apparatus by known means, such, for instance, as stirring paddles or arms, and the deposit formed being thereby constantly stirred up.

161449. Dr. HEINRICH WINTER, of Charlottenburg. March 3rd, 1903. *A means for cleaning centrifugal casings, for the purpose of separating more exactly drain of different composition.* In this arrangement, the means for cleaning the walls or casing of centrifugals in order to more exactly separate drain of different constitution consists, preferably, in spring scrapers or the like which fit exactly the wall of the centrifugal, being moved up and down at suitable intervals mechanically, and thus freeing the walls from adherent drain, so that the subsequent drain may be caught unmixed and conveyed to a separate collecting gutter. A modified form of the arrangement consists in the spring scrapers being constructed in a coaxially movable channel and connected with such a one, so that the scraping of the wall surfaces is completed by the drawing down of the scrapers, and in the last position the subsequent drain from the cleaned surfaces comes directly into the said movable channel.

161937. PAUL EHRHARDT, of Halle-on-Saale. 30th November, 1904. *An air agitating apparatus, more particularly for sugar mashes.* This air agitating apparatus, which is particularly adapted for sugar mashes, is provided with separate pipes introducing compressed air and immersed in the liquid, and its characteristic feature is that near the mouth of each tube, and commencing somewhat above the mouth, plates are arranged rising to the sides in such a way that these plates leave passages for the upwardly rising compressed air at their deepest points between them and their respective points, and also at their highest points between the edges of two adjacent plates.

NOTE.—Copies of all published specifications with their drawings in these lists can be obtained from W. P. Thompson & Co., 6, Lord Street, Liverpool, at One Shilling a copy for English or American Patents, and Two Shillings for German. In ordering please give number and date.

IMPORTS AND EXPORTS OF SUGAR (UNITED KINGDOM)

To end of July, 1904 and 1905.

IMPORTS.

Raw Sugars.	Quantities.		Values.	
	1904. Cwts.	1905. Cwts.	1904. £	1905. £
Germany	3,845,836	2,594,230	1,704,439	1,615,085
Holland	123,866	82,119	56,437	58,426
Belgium	225,004	281,918	97,393	209,686
France	153,566	118,999	71,854	88,098
Austria-Hungary	680,971	320,074	306,550	217,917
Java	1,034,877	1,513,756	428,871	1,097,360
Philippine Islands	....	....	....	....
Cuba	....	....	....	....
Peru	585,473	744,133	264,756	530,434
Brazil	82,210	36,864	31,171	23,887
Argentine Republic	....	....	....	....
Mauritius	321,538	138,417	117,181	78,350
British East Indies	153,468	379,194	62,136	207,459
Br. W. Indies, Guiana, &c.	777,870	833,286	503,012	683,931
Other Countries	401,622	637,586	185,602	446,368
Total Raw Sugars	8,386,291	7,680,576	3,829,402	5,257,001
Refined Sugars.				
Germany	6,872,610	5,967,382	3,859,151	4,896,992
Holland	1,853,545	830,675	1,092,605	717,578
Belgium	246,879	150,279	141,225	128,609
France	1,281,638	759,417	701,798	629,288
Other Countries	167,246	312,449	88,535	256,858
Total Refined Sugars	10,421,918	8,020,202	5,883,314	6,629,325
Molasses	1,046,271	1,403,202	193,323	281,722
Total Imports	19,854,480	17,103,980	9,906,939	12,168,048

EXPORTS.

British Refined Sugars.	Cwts.	Cwts.	£	£
Sweden	2,467	184	982	168
Norway	15,575	11,388	8,141	9,066
Denmark	72,355	45,528	36,420	34,407
Holland	34,128	42,759	17,870	34,547
Belgium	6,527	3,663	3,458	2,662
Portugal, Azores, &c.	9,422	9,175	5,029	7,015
Italy	2,565	1,972	1,208	1,394
Other Countries	192,549	142,537	121,277	132,789
	335,588	257,206	194,385	222,048
Foreign & Colonial Sugars.				
Refined and Candy	16,543	12,565	11,277	11,769
Unrefined	60,100	43,707	33,023	32,756
Molasses	1,559	2,640	888	793
Total Exports	413,790	276,118	239,573	266,366

UNITED STATES.

(Willett & Gray, &c.)

(Tons of 2,240 lbs.)	1905. Tons.		1904. Tons.
Total Receipts, Jan. 1st to Aug. 10th ..	1,143,619	..	1,193,020
Receipts of Refined ,, ,, ,, ..	748	..	314
Deliveries ,, ,, ,, ..	1,069,136	..	1,187,626
Consumption (4 Ports, Exports deducted) since January 1st	1,018,555	..	1,107,257
Importers' Stocks August 9th	74,483	..	17,555
Total Stocks, August 23rd	198,000	..	128,512
Stocks in Cuba, ,, ...	234,000	..	53,671
	1904.		1903.
Total Consumption for twelve months ..	2,727,162	..	2,549,643

CUBA.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1904 AND 1905.

(Tons of 2,240lbs.)	1904. Tons.		1905. Tons.
Exports	966,499	..	789,213
Stocks	115,198	..	290,438
	1,081,697	..	1,079,651
Local Consumption (seven months)	24,360	..	25,260
	1,106,057	..	1,104,911
Stock on 1st January (old crop)	94,835	..	—
Receipts at Ports up to July 31st	1,011,222	..	1,104,911

Havana, 31st July, 1905. J. GUMA.—F. MEJER.

UNITED KINGDOM.

STATEMENT OF IMPORTS, EXPORTS, AND CONSUMPTION FOR SEVEN MONTHS ENDING JULY 31ST.

SUGAR.	Imports. 1903. Tons.	1904. Tons.	1905. Tons.	Exports (Foreign). 1903. Tons.	1904. Tons.	1905. Tons.
Refined	549,826 ..	521,096 ..	401,010	1,242 ..	827 ..	628
Raw	344,728 ..	419,315 ..	384,029	1,798 ..	3,005 ..	2,185
Molasses	43,815 ..	52,313 ..	70,160	61 ..	78 ..	132
Total	938,369 ..	992,724 ..	855,199	3,101 ..	3,910 ..	2,945

	Home Consumption. 1903. Tons.		1904. Tons.		1905. Tons.
Refined	519,623	..	533,434	..	401,596
Refined (in Bond) in the United Kingdom	—	..	295,942	..	304,954
Raw	325,452	..	75,296	..	59,060
Molasses	38,189	..	48,907	..	65,311
Molasses, manufactured (in Bond) in U.K.	—	..	35,272	..	30,422
Total	883,264	..	988,851	..	861,343
Less Exports of British Refined....................	23,466	..	16,779	..	12,860
Total Home Consumption of Sugar	859,798	..	972,072	..	848,483

Stocks of Sugar in Europe at uneven dates, August 1st to 23rd, compared with previous Years.

In thousands of tons, to the nearest thousand.

Great Britain.	Germany including Hamburg.	France.	Austria.	Holland and Belgium.	Total 1905.
142	367	338	133	50	1080

	1904.		1903.		1902.		1901.
Totals	1506	..	1740	..	1790	..	907

Twelve Months' Consumption of Sugar in Europe for Three Years, ending July 31st, in thousands of tons.

(Licht's Circular.)

Great Britain.	Germany.	France.	Austria.	Holland, Belgium, &c.	Total 1904-5.	Total 1903-4.	Total 1902-3.
1603	1018	622	466	172	3882	4209	3433

Estimated Crop of Beetroot Sugar on the Continent of Europe for the current Campaign, compared with the actual crop of the three previous Campaigns.

(From Licht's Monthly Circular.)

	1904-1905.	1903-1904.	1902-1903.	1901-1902.
	Tons.	Tons.	Tons.	Tons.
Germany	1,575,000	1,927,681	1,762,461	2,304,923
Austria	893,000	1,167,959	1,057,692	1,301,549
France	625,000	804,308	833,210	1,123,533
Russia	940,000	1,206,907	1,256,311	1,098,983
Belgium	173,000	203,446	224,090	334,960
Holland	135,000	123,551	102,411	203,172
Other Countries .	340,000	441,116	325,082	393,236
	4,681,000	5,874,968	5,561,257	6,760,356

THE

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☞ The Editor is not responsible for statements or opinions contained in articles which are signed, or the source of which is named.

NOTES AND COMMENTS.

Blyth Bros. & Co. report shipments of sugar from August 1st to August 23rd at 3,698 tons, as compared with 5,564 tons for the corresponding period of 1904-05.

The Cost of Production in Java.

We would call the attention of our readers to the letter in our correspondence columns from Mr. H. C. Prinsen Geerligs, the Java sugar expert, who shows conclusively that but for the Brussels Convention having raised sugar prices to a more natural level, the majority of the Java sugar manufacturers would now be struggling to make both ends meet. We fancy our friends, the confectioners, will understand the significance of this phrase, for many of them, whom we shrewdly suspect have of late done more than make both ends meet, have nevertheless filled the press with laments about the impending ruin of their industry, in which case they will appreciate the desire of the Java planters to escape from a period of low prices such as occurred in 1902, but which the confectioners themselves would fain see continue, like the brook, "for ever." If the latter had their way, it would only be for a time, as the partial ruin of the Java sugar industry would speedily follow, and would have a very marked effect on the sugar market. Even nowadays, the diverting of one or two cargoes of Java sugar from Europe to America has

its influence on the market. What the effect of a reduction of the Java crop by 50 or 75% would be, may be left to the imagination of our readers. Moreover, what Java could not stand, neither would Hawaii, and the latter would suffer even more, unless the U.S.A. took up her crop on advantageous terms.

A Paris Tragedy.

M. Jaluzot's failure, to which we referred last month, has been followed up by another. This time it has been the fate of M. Cronier, the head of the great Say Refinery; and the unfortunate man, unable to face the dishonour he had brought on himself, put an end to his life. The amount of his losses is placed as high as 89,000,000 francs, and the Société Général des Sucreries et de la Raffinerie d'Egypte, and the Daira Sanieh Company, concerns which he was instrumental in starting, are alleged to be involved in the loss, the former to the extent of 25,000,000 francs. On the other hand, the Say Company are equal to all the calls made on them. Hamburg firms are hit to the extent of £2,000,000, and London ones of £500,000. Besides that, M. Cronier lost in his speculations the entire estate of the late Henri Say, of which he was trustee, amounting to 23,000,000 francs, and not content with gambling in sugar, he was heavily involved in Kaffirs. All this goes to accentuate the moral we drew last month on the evils of such speculations. If this second crash, coming so soon after the first, leads to some restrictions being placed in the way of future attempts of this kind, some good will have arisen out of the evil.

Business Enterprise.

As showing what can be done by using a traveller, we may cite the case of British Trade in Angola. Here, according to the Consul at Loanda, British manufactures do not hold their own, simply because they are not pushed. One American firm, on the other hand, sends out a representative annually, and consequently sells almost all the plantation machinery used in the country. They have just booked an order for a sugar mill of the largest size for Loanda.

We think it might be well worth the while of some of our home manufacturers to send a competent representative round the coast of Africa, as that continent is going in for sugar cultivation on an ever increasing scale.

Prosperous Natal Sugar Companies.

The Directors of two Natal sugar companies—Reynolds Brothers, Limited, and the Tongaat Sugar Company, Limited—have just issued their reports for the year ended May 31st last, and in both cases results of an extremely satisfactory character are recorded,

showing that the Natal sugar industry has prospered materially during the past year. Reynolds Brothers, after making due provision for depreciation in all departments and for other contingencies, show a credit balance of £20,617 1s. 11d. Out of this sum the Directors propose to pay a dividend of 10 per cent. and a bonus of 10 per cent. on the ordinary shares, 8 per cent. on the preference shares, and 10 per cent. and a bonus of 10 per cent. on the deferred shares. To reserve account £8,000 is transferred, while a balance of about £3,000 is carried forward. In addition to this the surplus funds available enable the Directors to redeem, this month, £15,000 of the company's 6 per cent. first mortgage debentures. The year's profit of the Tongaat Sugar Company, after making provision for depreciation, &c., amounts to £12,377 14s. 4d., and as a sum of £3,399 8s. 2d. was brought forward from last year, a total of £15,777 2s. 6d. becomes available for distribution. Of this £2,800 is to be devoted to the payment of the arrears of preference dividend, and £3,600 to interest on debentures, which leaves £9,377 2s. 6d. available for the payment of one year's dividend on the ordinary shares at 7½ per cent., and one year's dividend on the preference shares at 7 per cent., £2,077 2s. 6d. being carried forward to next year's account. The company's cash balance aggregates about £10,000.—(*South Africa.*)

European Sugar Consumption, 1904-05.

The *Journal des Fabricants de Sucre* gives the following figures of consumption for the first eleven months of the 1904-05 campaign, as compared with those of 1903-04:—

	1904-05. Metric Tons.	1903-04. Metric Tons.
France	495,771	699,030
Germany	775,056	1,126,432
Austria-Hungary	404,516	503,962
Belgium	63,068	85,431
United Kingdom	1,392,824	1,566,869
Holland	82,246	88,355
	3,213,481	4,070,079

Difference, 856,598 tons.

Amongst the Consular Reports in the present issue will be found some useful advice to sugar machinery manufacturers from the British Consul of Tainan, South Formosa. One of the results of the new Anglo-Japanese Alliance will in all probability be that what Japan cannot readily produce herself she will give the first refusal for to Great Britain. British manufacturers will, therefore, do well to accommodate themselves to the requirements of the Eastern customer.

The Ethics of Journalism.

We regret to have to draw attention to the fact that there is an increasing lack of care shown by our colonial and American contemporaries to credit sundry articles to the rightful originators. In international journalism, the claims of copyright are difficult to substantiate, and as a rule are seldom brought forward. We, ourselves, would hesitate before taking any such step, knowing that we are often indebted to our exchanges for articles of interest. But the principle of copyright exists in theory, and therefore the least that can be expected from those who help themselves to other's articles, is that they credit these articles to the journal which was responsible for producing them. When the question of translation arises, it will be conceded that the translator has sole rights to the translation unless, indeed, the original article was marked "Translation reserved." If a French paper A has an article which is translated into English by an English paper B, B is surely entitled to full credit for the translation; and when three or four other Anglo-Saxon papers reproduce this translation, their crediting it to A only does not take account of the labour involved in translating. Nay, more, they *ipso facto* credit themselves with this work, whereas, theirs has been but a "scissors and paste" affair. We have commented at length on these principles, because we have been of late a sufferer in these respects. Two articles appeared in our April and May issues respectively, viz., "The manufacture of sugar in the Colonies," and "The beetroot and the sugar cane—Th. Dufau," which we got translated by an expert from the French paper in which they originally appeared. Needless to add we credited this paper for them. Now we find these articles have been bandied about in Indian, Colonial, and American papers; and in not one case was the translation, which was copied verbatim from our journal, credited to us. We think we have every reason to complain, when we are put to trouble and expense to get a correct translation prepared, that this latter is reproduced in half-a dozen papers in various parts of the world without one word of thanks. The most they did was to give the name of the French paper, to whom they were not indebted for what they printed. We trust, therefore, that our contemporaries will in future give credit to those to whom credit is due, and not allow international journalism to degenerate to petty filching of contemporary work, secure in the supposition that the difficulty and the expense of enforcing a claim for copyright would be too great to be resorted to by the aggrieved party.

According to the Melbourne *Argus*, the central mill system in Queensland has not so far proved a success. Of thirteen mills built directly or indirectly under Government control, eight have not fulfilled their monetary obligations to the State.

PROGRESS IN THE WEST INDIES.

Mr. Robert Harvey, M.I.M.E., of Glasgow, recently penned a letter to the *Glasgow Herald*, in which he showed that the West Indians are certainly realizing the necessity of getting more modern sugar machinery, and that they show a decided preference for British plant.

He wrote :

I was much interested, in reading your London Letter in your issue of Friday, September 1st, with regard to the West Indies and the prospects of prosperity for these islands. I agree with the writer that the old-time planter is now becoming a thing of the past in the West Indies, and the younger men now in the business are adopting more up-to-date methods both as regards the cultivation of the land for sugar cane, also as to the method and the machinery that should be used in turning the same into marketable sugar. I beg, however, to differ from your correspondent regarding the English sugar engineers being behindhand in adopting new methods in the manufacture of sugar and sugar machinery. It may be something new to your correspondent to know that even with the superior yield of the land in the Hawaiian Islands, and with all the improvements in American sugar machinery, sugar is at present made in the West Indies as cheaply as in the Sandwich Islands. Furthermore, as steam ploughs and irrigation are now being introduced into the West Indies, the cost of making sugar will be still further reduced.

The extra large yield of canes per acre mentioned by your correspondent in the Sandwich Islands is, as he states by ploughing, draining, and irrigation, but this at great expense. In fact, the estates are handicapped there by irrigation machinery at enormous expense; and over and above this, the cost of the upkeep of drains and working them is about £5 per acre per annum, which has to be reckoned with in arriving at the cost of their canes per ton, and the American ton is 2,000 lbs. against our English ton of 2,240 lbs.

The first consideration in the making of cheap sugar is the cost of producing the canes. The lower the rate at which this can be done, the cheaper the sugar, and by the use of the steam ploughs, and irrigation, the weight of canes per acre should be about double what it is at present with hand labour in the West Indies.

Your correspondent states in his letter that the ingrained conservatism of the British manufacturer sometimes makes it impossible to do business with him. This may be true in some cases, but I question the truth of the statement as regards sugar machinery. I have been visiting Cuba and Porto Rico this last winter, and found as a rule in those up-to-date sugar islands that English machinery was much preferred to American. In Porto Rico there is a duty against English machinery of 45 per cent., owing to Porto Rico having been seized by the Americans and incorporated as an American State. This 45 per cent. would naturally prevent the introduction of further English machinery; but such is not the case, as many of the planters inform me from their experience of American machinery, after having used English

machinery, it would be to their advantage to pay the 45 per cent. duty so as to secure English machinery, and in some cases this has been done. This speaks for itself as to the superiority of the English sugar machinery. Many of the American ideas, I confess, are very clever and useful: but, in other cases, I have seen most elaborate and expensive machinery in use with results which could have been accomplished by labour on the spot for less money than the interest of the capital invested in the machinery adopted for the purpose.

Your correspondent hints that the English sugar engineers do not go with the times in improving their designs. This is contrary to the facts, as we are continually making new designs, and improving our machinery and methods for the manufacture of sugar, which is borne out by the low price at which the sugar is now produced in the West Indies—about £2 per ton under the cost at which beet sugar can be produced in Europe.

SIMPLE METHODS OF CHEMICAL CONTROL.

By T. H. P. Heriot, F.C.S.

(Continued from page 419.)

IV.

Preparing a Solution for Analysis.

The first step in making a quantitative analysis of a solid substance is to prepare a solution containing a known weight of the sample in a known volume, by combining the two operations dealt with in the last chapter. For example, the percentage of pure sucrose in a sample of low grade sugar is determined in a solution prepared by dissolving, say 20 grams of the sugar in water, and diluting the resulting solution to a definite volume, say 100 c.c. The method of weighing is, in this case, slightly complicated by the fact that the sugar (or other substance) must not be placed directly on the left-hand pan of the balance, but in a previously weighed vessel; the German silver basin, *Fig. 9*, being used for this purpose.

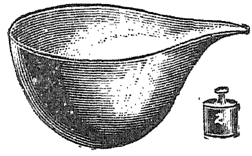

Fig. 9.

(Note.—The basin is provided with a counterpoise weight, the top of which unscrews so that the exact tare may be adjusted, if necessary, by adding or removing a small fragment of wire or tinfoil. The weight should be kept in the drawer of the balance case.)

The empty basin being accurately counterpoised, the 20 gram weight is added to the counterpoise weight on the right hand pan, and the sugar added to the basin by means of a small spoon or the bone spatula. After each addition, the balance is "tried" by slightly turning the milled screw, and the quantity in the basin increased or diminished until the pointer swings equally on both sides of the zero.

Removing the basin from the balance, and supporting same upon a cork-ring * the chemist should now be seated at the table. 40 c.c. of rain water are measured off in one of the larger graduated cylinders, poured into the basin, and the contents stirred with a glass rod. When the sugar appears to have dissolved, the resulting syrup is decanted into a 100-110 c.c. measure flask in the manner shown in *Fig. 10*; the rod being held so that the lower end touches the interior of the neck of the flask. Replacing the rod in the basin, 30 c.c. more water are

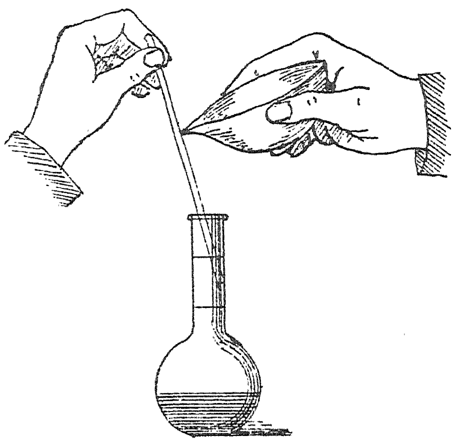

FIG. 10.

added, and this will completely dissolve any trace of sugar left in the basin. After this has been similary decanted, 10 c.c. of water are slowly poured down the rod while the latter is moved round the upper part of the basin so as to wash down any drops of syrup from the sides of the basin and rod, and this wash water added to the flask as before. A final rinsing with another 10 c.c. of water will completely remove the last trace of sugar from the basin. The contents of the flask are then diluted exactly to the 100 c.c. mark, by adding water from a pipette as already explained.

(NOTE.—The object of measuring the water into the basin is merely to avoid a too liberal use of water for dissolving which might nearly fill the flask before the basin and rod had been rinsed.)

* This, and a few other sundries, will be mentioned in an Appendix to the List of Apparatus given in Chapter 2.

The contents of the flask must finally be thoroughly mixed by closing the mouth of the latter with the thumb while the neck of the flask is gripped between the fingers and the palm of the hand, and then inverting the flask several times.

Such a solution serves as a starting point for many separate tests and analyses, because the 20 grams of sugar dissolved therein may be accurately subdivided by withdrawing measured volumes of this solution. Thus, 10 c.c. will represent a tenth of the whole, or two grams of the original sample; 50 c.c. half, or 10 grams; and so on. Although we shall not have occasion to adopt this practice, the following experiment is instructive as illustrating how the chemist is able to deal with weights too minute to be detected by the most sensitive balance.

Starting with the above 20% solution, measure off exactly 10 c.c. in the pipette, and transfer this volume to a second 100 c.c. flask, fill up the latter exactly to the 100 c.c. mark with water, and mix as before. The result is a 2% solution, from which, by repeating the operation (using a clean pipette and a third flask) a 0·2% solution is obtained. By mere repetition of these simple measurements the dilution may be carried on until the last flask contains the merest trace of sugar, the weight of which *is still known*, although probably represented by the fifth or sixth place of decimals. The same result would be reached in one-third of the time if 1 c.c. of the original solution had been diluted to 1,000 c.c. (1 litre) and so on. We thus prove that infinitesimal quantities can be measured without substituting "theory" for "common sense" at any step of the process.

To return from the above digression. A complete analysis of our supposed sample of raw sugar would necessitate the separate determination of sucrose, glucose, moisture, and ash. Here, however, we are aiming at simplification, and it fortunately happens that the determination of the chief constituent, the sucrose, is rendered very easy by taking advantage of a curious optical property possessed by sugar solutions; a property which can be accurately measured in the now familiar polariscope, an instrument which will occupy our attention later on.

Turning to our 20% solution, as prepared above, and which will be more or less cloudy and coloured, some further preparation is necessary before the liquid can be rendered sufficiently transparent for the optical test. Many liquids can at once be rendered clear by filtration through a special kind of paper, but this is quite impossible in the present case. (NOTE.—The reader may test this statement after reading the instructions for filtering given below.) All difficulty is avoided, however, by adopting a course which closely resembles the "tempering" of juice in the factory, but which will be found much more effective. Instead of the combined action of heat and caustic lime (whereby the raw mill juice is rendered capable of

filtration through cloth) the "clarifying agent" employed in the laboratory is a solution of basic acetate of lead.*

Filling a 50–55 c.c. flask exactly to the lower mark with the 20% sugar solution, add 2 c.c. of lead solution from a pipette, dilute with water exactly to the 55 c.c. mark, and mix thoroughly. The result is a milky liquid which, on merely standing for a short time, separates into two portions,—a precipitate which slowly settles in the flask, and a transparent and almost colourless liquid.

The greater part of the soluble impurities present in the original sample have here combined with the acetate of lead to form highly complex and insoluble compounds, which, taking the form of a precipitate, envelop and carry down the fine insoluble particles which rendered the original solution cloudy. The dissolved sucrose being unaffected by the acetate of lead, the saccharine richness of the original solution has only been modified by the dilution, and this being exactly one-tenth, a very simple correction can be applied. This method of clarification *by dilution* will be found convenient when we come to analyse the juice, but when preparing a solution as above, it is more convenient to add the lead acetate before adjusting the volume of the sugar solution in the flask by proceeding as follows:—Wipe the metal basin perfectly dry, counterpoise it on the balance, and weigh out another 20 grams of sugar. Dissolve and decant the solution as before, but add 2 c.c. of lead acetate to the flask after the first or second decantation. Rinse the basin twice, dilute to the 100 c.c. mark, and mix. When this is filtered, the clarified liquid will be a 20% solution of the original sample, requiring no subsequent correction.

Fold one of the circular discs of filter paper in half, and re-fold the doubled portion (so that the single folds come together). Repeat this re-folding twice again and the result will be as in *Fig. 11*. Opening out the paper, the "fluted" filter, shown in *Fig. 12* is obtained, which fits into the glass funnel,† as in *Fig. 13*. The funnel is supported in one of the small hydrometer cylinders, and the contents of the measure flask carefully poured on to the paper, the funnel being then covered with a ground-glass plate to prevent evaporation.

The first portion of the filtrate is always cloudy, but as soon as the drops falling from the funnel appear perfectly bright, the funnel is cautiously lifted and placed in a second (dry) cylinder, which will gradually fill without requiring further attention.

Practice in the foregoing manipulations may best be postponed until we have described how to use the polariscope, so that the accuracy

---

*NOTE.—One of the small bottles, with flat stopper, should be filled with this reagent and labelled "Poison"; the Winchester quart bottles being stowed away in the cupboard.

†NOTE.—The stems of the funnels are shortened by making a file-mark round the stem, firmly grasping the latter on each side of the mark, and then drawing the hands apart with a jerk, at same time exerting a slight bending strain.

of the work may be checked by the optical readings of several solutions, prepared from the same sample of sugar.

A clear distinction should now be drawn between percentage *by volume* and percentage *by weight*. If we mix 20 grams of sugar with 80 grams (= 80 c.c.) of water we obtain a solution weighing 20 + 80 = 100 grams, and therefore a 20% solution of sugar *by weight*. But the percentage *by volume* will be more than 20 because the 80 c.c. of water employed are not increased to 100 c.c. by the addition of the sugar, but to somewhat less than 90 c.c. Consequently, if 90 volumes contain 20 grams, 100 volumes contain 22 grams, so that the same solution may contain 22% by volume and 20% by weight.

Conversely, the 20% solution by volume (see the first experiment described above) would have weighed more than 100 grams, say 105 to 106 grams, and therefore must have contained less than 20% by weight.

FIG. 11.

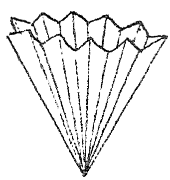

FIG. 12.

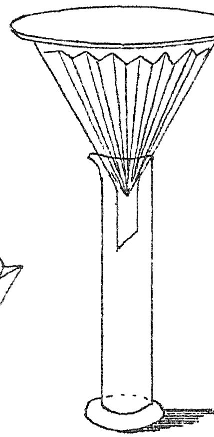

FIG. 13.

This distinction being once clear, it is merely a matter of convenience whether percentages are expressed by volume or by weight; the former being preferable in the case of liquids which are measured and the latter in the case of solids which are weighed. Actual examples will appear in subsequent chapters.

At this early stage of our enquiry, the necessity of absolute cleanliness in the laboratory cannot be too strongly insisted upon. As regards the balance, in addition to keeping the case dusted and the window clean, it will occasionally be necessary to dust and polish the pans. Whenever the balance appears to require re-adjustment, suspicion should fall upon the pans, and these should be inspected and polished with the leather before the adjustment-nut is interfered

with. It is also hardly necessary to remark that every object placed on the balance-pan must be scrupulously clean and dry.

All glass-ware should be washed at the sink immediately after use and not left over for a "cleaning-up" day, when everything is dirty. If, after being properly washed and left to dry on the draining rack, the glass-ware still looks dirty, this will be due to the impurity of the water supply, and it will be advisable to have a vessel of rain-water handy, into which the washed apparatus can be dipped before being left to drain. The measure flasks, in which juice, &c., has been treated with basic acetate of lead, can be cleaned by rinsing with dilute muriatic acid (one part of acid to one of water). As this acid can be used over and over again, it may be kept in an open phial or cylinder into which the acid rinsings are emptied back. The flasks are then washed free from acid, rinsed with rain-water, and left to drain.

A spare bucket, kept underneath the sink, serves as a receptacle for all rubbish, including the used filter papers removed from the funnels.

One secret of tidiness is to stow away in the cupboard all appliances other than those in daily use, and, in order that these spares may be always ready for use, dust must be excluded by plugging measure flasks, pipettes, &c., with cotton-wool, and by covering cylinders with paper caps.

Finally, by utilising the sink as a working bench for taking densities and for similar operations likely to make a mess, the "balance table" will always be available for carrying out the more delicate operations.

These trifling hints will enable the planter or overseer to drill a native boy into an efficient bottle-washer and assistant, whose duties may be subsequently extended if he shows intelligence.

(To be continued.)

Another cane-cutter has been invented by the son of an American ex-Senator that is said to bid fair to revolutionise the sugar planting industry of the Southern States of America. It is claimed that the machine will do the work of more than one hundred men. We shall, however, see how far these claims are fulfilled in practice.

British and American inventors, who are interested in the far eastern trade, are advised to protect their inventions in Japan prior to the publicity given in that country to their inventions through the medium of the official patent office gazettes of their respective countries. Otherwise they may find their inventions classed as "publicly known" and therefore unpatentable.

WORLD'S PRODUCTION AND CONSUMPTION.

The visible consumption of sugar during the campaign 1904-5, now closing, proves to have been the smallest in many years, due to the fear of a shortage in supplies which led to wild speculation and high prices early in the year. Actual consumption probably did not fall off very materially, but heavy inroads were made in the invisible stocks, leaving but very few sugars carried anywhere in statistical countries, except the visible stocks, which are now larger than was anticipated.

It will be interesting to look ahead and consider the question of supply and demand for the next campaign year, based on present indications, although it is early to estimate the outturn of crops.

In leading commercial circles of Europe it is expected that the new beet crop will produce 6,300,000 tons sugar, based on the sowings of this year and a yield equal to that of campaign 1903-4, when conditions were favourable.

The Cuba, Brazil, and other cane sugar crops, as well as the beet crop in this country, are all doing finely, giving promise of a total outturn of cane and U. S. beet amounting to something like 5,200,000 tons sugar.

From the present outlook we may reasonably expect a total production of 11,500,000 tons beet and cane sugar in the world for the new campaign 1905-6, or 500,000 tons more than the crops of 1901-2, which were the largest on record up to this time.

Prices having declined to normal figures, there seems to be nothing to prevent a full and free distribution of sugar during the next twelve months, for actual consumption and to fill up the depleted invisible stocks, which should cause the largest visible consumption on record.

We give below our latest estimates of world's production and consumption:—

	Tons.
Visible supply (stocks and afloats) September 1st, 1901	1,145,930
Production, 1901-2	10,993,346
Total supply, 1901-2	12,139,276
Consumption, 1901-2	10,057,477
Visible supply, September 1st, 1902 (invisible stocks large)	2,081,799
Production, 1902-3	9,936,755
Total supply, 1902-3	12,018,554
Consumption, 1902-3	9,904,463
Visible supply, September 1st, 1903 (invisible stocks small)	2,114,091
Production, 1903-4	10,295,276
Total supply, 1903-4	12,409,367
Consumption, 1903-4	10,817,762

Visible supply, September 1st, 1904 (invisible stocks large)	1,591,605
Production, 1904-5	9,377,345
Total supply, 1904-5	10,968,950
Estimated consumption, 1904-5	9,603,950
Estimated visible supply, September 1st, 1905, (invisibles small)	1,365,000
Estimated production, 1905-6	11,500,000
Estimated total supply, 1905-6	12,865,000
Estimated consumption, 1905-6	11,000,000
Estimated visible supply, September 1st, 1906 ..	1,865,000

(Willett & Gray's Circular.)

THE WORLD'S TRADE.

A Board of Trade return recently issued once more illustrates the remarkable development of British trade. The following abstracted list shows the turnover for the years 1903 and 1904, the imports representing (except in the case of the United States) articles for domestic consumption, and the exports being in every instance articles of domestic produce. In regard to Belgium, the principal articles only are dealt with :—

IMPORTS.

	1903. £		1904. £
United Kingdom	473,027,000	....	481,040,000
Germany	300,134,000	....	314,549,000
United States	207,395,000	....	215,814,000
France	192,048,000	....	181,458,000
Belgium	101,689,000	....	104,758,000
Austria-Hungary..	78,213,000	....	85,211,000
Italy	74,478,000	....	74,325,000
Japan	32,102,000	....	37,588,000

EXPORTS.

	1903. £		1904. £
United Kingdom	290,800,000	....	300,818,000
Germany	250,732,000	....	258,625,000
United States	303,677,000	....	297,031,000
France	170,090,000	....	179,020,000
Belgium	79,875,000	....	82,211,000
Austria-Hungary..	88,741,000	....	86,220,000
Italy	60,697,000	....	64,608,000
Japan	28,994,000	....	38,011,000

ANTIGUA.

The Central Sugar Factory.

In our February number we gave a short account of the new central factory which the Mirrlees Watson Co. were erecting in Antigua. Some further account of this new concern was given by the Hon. Francis Watts, C.M.G., in a recent number of the *West Indian Bulletin*, and we take the following details from his paper:—

It appears that early in 1903 Sir Gerald Strickland, the Governor of the Leeward Islands, ascertained that a residual sum, arising out of the Parliamentary Grant of £250,000 to assist the West Indian Sugar Industry, was available for application within his Government if satisfactory proposals could be put forward. Such proposals were advanced and took the form of a £15,000 bonus towards a central factory scheme.

It is unnecessary to go through the various negotiations; suffice it to say that after much hard work and anxious moments a company was found prepared to fulfil the requirements of the Government, and to make what should prove a good bargain for itself and the Antigua sugar planters.

The position is: the factory and the estates' proprietors have agreed to co-operate, the former to build and work the factory, the latter to grow and supply the canes, during a period of fifteen years, on a profit-sharing basis. The capital of the factory is £40,000, including the £15,000 contributed by the Government. The company agreed to erect a well equipped factory capable of making 30 tons of 96° crystals in a day of 23 hours. They further agreed to pay for canes the equivalent price of 4½ tons of 96° crystals, f.o.b. Antigua, for each 100 tons of canes. This may be regarded as a payment "on account." After the payment of working expenses, interest on capital, and setting aside of a reasonable amount to sinking and reserve fund, any profits which arise are to be dealt with in the following manner: Should the price paid for canes prove less than 10s. per ton, then the profits shall be applied to bringing up the payment to 10s., or as far in that direction as the amount available permits. If after canes have been paid for at 10s. per ton, or over, any profits still remain unallotted, these profits are to be divided equally between the shareholders of the company and the estates' proprietors supplying canes.

Of the £15,000 contributed by the Government £1,000 is amortized each year, so that at the end of fifteen years this will disappear from the company's capital account. As soon as the £25,000 subscribed by the company shall have been paid off, the ownership of the

factory will be divided equally between the shareholders in the company and the estates' proprietors supplying canes.

The estates' proprietors bind themselves to maintain a certain acreage in cultivation with sugar-canes, and to supply the canes so grown to the factory for a period of fifteen years.

In addition to this the company is under an obligation to the Government to take, if offered, canes from the peasantry up to 4,500 tons a year at a price equal to the value of $4\frac{1}{2}$ tons of 96° crystals, f.o.b. Antigua, for each 100 tons of canes, but with the proviso that the price to be paid for peasants' canes shall in no case be less than 7s. 6d. per ton; good, sound canes being stipulated for.

Eight estates have entered into co-operation with the Factory Co., and have agreed to supply canes from an area of 1,620 acres in each season. This area, together with the peasants' supply, is expected to yield 3,000 tons of sugar.

The machinery erected is as follows:—

2 Babcock and Wilcox water-tube boilers, having 11,528 sq. ft. of heating surface, and able to work at a pressure of 160 lbs., but fitted with reducing valves to supply steam to the factory at 100 lbs.

A steam engine with cylinders 26 in. × 48 in.

2 three-roll mills, 60 in. × 30 in., with provision for maceration.

A triple effet with 4,000 sq. ft. of heating surface.

2 juice heaters each having 2,000 sq. ft. of heating surface.

2 vacuum pans, each capable of striking 15 tons of masse-cuite, or 9 tons of dry sugar.

A central condensing installation.

5 Weston 36 in. belt driven centrifugals, 3 for first sugars and 2 for seconds. These are provided with all the necessary pugmills, grass-hopper sugar conveyors, and chain and bucket elevators.

6 second sugar crystallizers, fitted with stirring gear, each capable of holding a full strike from one of the vacuum pans.

The machinery is housed in buildings constructed of rolled steel columns of H section, and covered with galvanized iron. The mill house is provided with a travelling crane, capable of lifting 12 tons. The buildings and mill yard are lighted by electricity. Finally, a small laboratory provides accomodation for the resident chemist.

Six miles of railway have been laid down to convey the canes from the estates to the factory. The rails are 30 lbs. to the yard, and the gauge is 2 ft. 6 in. There are two locomotives for haulage purposes.

The cost of the factory, so far as can be ascertained at this stage, has been approximately as follows:—

	£	£
Cost of plant	21,315	
Additions to plant	633	
Houses, offices, laboratory, &c.	1,000	
Freight..	3,467	
Lighterage, insurance, package tax, &c. ..	683	
Erection (not yet fully known), say	7,500	
Water tower, ponds, pipes, &c.	700	
Sundries	400	
Legal..	360	
Consulting engineer	350	
	£36,408	36,408
Railway, 5½ miles line and construction ..	3,840	
2 Locomotives	980	
120 Waggons	1,100	
Sundries	80	
	£6,000	6,000
		£42,408

The estimated sum of £40,000 has thus been exceeded by £2,408. These figures at this stage can only be given as approximate and provisional. The cost of the plant is extremely low. For safe estimating for any other factory £50,000 should be allowed.

It is interesting to learn that the honour of "C.M.G.," conferred on the Hon. F. Watts a short while ago, was meant to be a mark of approval of his efforts in the planning and construction of the above described central factory.

PERSONAL IMPRESSIONS OF CUBA.

By Dr. Herzfeld.

(Continued from page 431.)

After the experiences of the first day, Dr. Herzfeld gave up his intention of visiting the Santa Lucia Usine, because he found he could not get there till the afternoon when the rain would be sure to fall. He preferred to take a journey across the country, and visit one of the largest factories in the island, viz., Caracas. He had received from Dr. Wiechmann, on leaving New York, quite a bundle of introductory notes to various plantations and persons in Cuba, written by the directors of the American Sugar Refining Co. As this Company exported last year about 80% of Cuba's total output, they naturally had control of all the largest sugar factories. Amongst these introductions was one to Snr E. de Terry, the owner of Caracas in the Province of Santa Clara. Dr. Herzfeld wrote to announce his coming,

and then next day he and his party left early in the morning by train for Santa Clara which they reached at 10 o'clock in the evening. The scenery en route was very varied. First came virgin forest, in which are to be seen, here and there, orange and citron trees; these, however, get speedily choked with creepers and wild gourds. Next appeared palm groves, then mountain peaks bedecked with large palms, then again enclosures full of large and small palms all withered up by a recent drought. Near to Puerto Principe, the chief town of the Province of that name, numerous pastures full of cattle were visible. So many cattle are seen in Cuba that one is at a loss to understand how there can actually be a scarcity of them for animal traction. Yet so it is, for whereas before the Insurrection there were some two millions, in 1900 there were only from 200,000 to 300,000 head of cattle, and since then the number has not increased sufficiently to make cattle importing unprofitable.

The midday meal, taken at a station while the train waited, was unbearable owing to the heat. And while in motion, the train so rocked that conversation was out of question. On arrival at Santa Clara late at night, the travellers went to an hotel where they were welcomed. In fact, being Germans, they were everywhere esteemed. At first, people were suspicious and reserved as long as they thought the visitors were Americans, but as soon as it was learnt they hailed from Germany, the natives' manner changed in a twinkling.

Although exhausted from their long journey, Dr. Herzfeld and his party were up early next morning to train to Cruces, the terminus of the branch line to Caracas. At Cruces a stationmaster knowing some English was found, and he telephoned to Caracas to announce the impending arrival of the party. Snr. Terry replied that if they would come by the train leaving in an hour's time they would be welcome. They thereupon employed this hour in going to the Cruces hotel and convincing themselves that it was impossible, at least for a European, to spend a night there (Cruces has a population of 12 to 15,000). In Cuba, when visiting factories and unable to stay overnight at them, it is necessary to repair to the chief town of the province for the night. There are in the whole of Cuba but six towns where one can stay more than a day, and even then it is not always in comfort; one has to be contented with the most primitive arrangements. But in such a dirty and fly-plagued spot as Cruces it was impossible to dwell. Moreover, personal safety is not guaranteed; the streets are never lighted, and in the darkness one may easily fall among thieves.

After enjoying the flies at the hotel—where all dishes are kept upside down and only reversed the moment before the food is placed in them—and convincing themselves that no one in the place understood a word of English, the party returned to the station where the narrow gauge railway belonging to the factory started. Caracas

plantation possesses 90 km. of railway line. All cane is carried by rail to the factory, the harvesting area amounting to 12,000 hectares. As at Santa Ana there was no real road here, and it would have been impossible to drive a vehicle to the factory. The ground is a deep loam. Where the canes were loading, portable tracks were laid as near to as possible. The wagons were of ingenious construction, and were fitted with automatic discharge. On arrival at Caracas the party were welcomed by Snr. de Terry, the head of one of Cuba's best families. He lives during the campaign in Cuba and the rest of the year in Paris. He at once took them round his splendid factory. Here, too, the building is open at the sides, but the roof rests on iron pillars, and the apparatus is modern and of iron, not copper. (A detailed account of this factory appeared not long ago in the *Journal des Fabricants de Sucre*,* so Dr. Herzfeld refrained from repeating the particulars. A few remarks were, however, not out of place.) In one corner was the diffusion battery—supplied, as is nearly all the plant, by the Fives-Lille Co.—now standing idle, but in the hope of being once more put to work. The methods employed are as simple as at Santa Ana. It is true the output is better, thanks to the improved apparatus, but how much chemical control is exercised may be imagined when it is stated that the chemist once employed was dispensed with, as no use could be found for his services, and the laboratory which he fitted up now stands empty. A very interesting apparatus was the water condensation plant which stood in the yard and was erected by a German firm. The water is first squirted into the air and then further cooled on large horizontal iron surfaces.

Attached to the factory were splendid dwelling quarters that more nearly resembled an hotel. Here, as a result of a conversation with the factory overseer, the following information was gleaned.

Previous to the war, the number of factories in Cuba was 574. Of these, 483 were destroyed, for only 91 survived the war. At the present day their number is 186. It will be seen how greatly the capacity of these factories has increased when it is stated that these 186 turn out more sugar than did 574 before the war. A railway journey through the country reveals many an old ruined factory, for no attempt was made to rebuild them. Instead, one large establishment has been erected in the midst of the area occupied by two or three old ones.

About 400,000 to 450,000 acres of land are under sugar cane cultivation in Cuba, or say 160,000 hectares. By way of comparison it may be mentioned that the German beet area in 1904 reached 416,000 hectares. But it is to be observed that Cuba has at present in cultivation only a little more than one third of the soil which is required for beets in Germany.

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* See *I.S.J.*, January, 1905.

The cultivated land is taken up as follows :—

47·3 %	with	cane.
11·3 %	,,	sweet potatoes.
9·3 %	,,	tobacco (the annual crop being 30,000 tons).
8·6 %	,,	bananas.
7·3 %	,,	maize.
1·6 %	,,	coffee.
0·5 %	,,	rice.
0·3 %	,,	pineapples.
0·3 %	,,	oranges.
0·2 %	,,	onions.

The total area of cultivated land is put at one million acres, but it is hoped another like amount may eventually be reclaimed. All those who know the island well are agreed that at some future date—how soon no one professes to know—the sugar production will be doubled or a little more than doubled. But further than this it will certainly not go, and all talk of a crop of six million tons is beyond the bounds of possibility.

The mean sugar crop in Cuba amounts to from 58 to 65 tons per hectare (23 to 26 tons per acre). When it falls to 20 tons the land is freshly planted. But in Cuba the cane plants last five or six years at least, and often eleven or twelve years. This is the difference between Cuba and Java, where fresh plants are put down every three years. There are even fields in Cuba where for forty years canes have been cultivated and only in isolated spots new plants been laid down. The period of vegetation of the cane is commonly 12 to 13 months. An advantage is here possessed by the cane over the beet in that the cane grows throughout the whole year. It naturally requires correspondingly less nutrition. Freshly planted cane requires 18 months to grow before maturing. The new fields now laid out are not available for the next campaign, but await the following one. A factory worker in Caracas gets 30 dollars, a field worker 50 dollars. But the latter works only in fine weather; when it rains, he has to cease work. When this visit was paid to Caracas only half the hands were at work. It was intended to stop altogether in the following week, but later on possibly to work for eight days more.

A visit was next paid to the fine private house of Snr. de Terry, the walls of which were adorned with fine oil paintings. Before taking leave, their host gave them an introduction to the proprietor of Rosario Don Pelajo, as Dr. Herzfeld had expressed the wish to see this factory. They then returned to Cruces, explored the place, and bought some photographs of Caracas factory; incidentally, they were glad to discover that beggars were not a feature of Cuban streets.

In the evening they took the train back to Cienfuegos. The rain had come on as usual, so nothing further could be done that day.

As they were all exhausted, they resolved not to visit a factory next day. But five o'clock found them at the station, where they entrained for the town of Matanzas. The place was reached by three o'clock in the afternoon; it lies on the coast, and is even more beautifully situated than Havana. The party hired a vehicle and went sightseeing for the rest of the day. Next morning a start was made at six o'clock for the station of Aguacate, where a team was in waiting for the party. In contrast to previous roads the one the vehicle proceeded to traverse was a fine and well-made one. Rosario is, in contrast to Caracas, a plantation where the canes are transported by teams, not by railway wagons, and a network of good roads takes the place of the usual railway tracks. This factory works up 100 tons per diem, and is still considered a big place, though it has only half the capacity of Caracas. Dr. Herzfeld and party were welcomed by the manager of the factory, a very agreeable man who understood English and Spanish equally well. He first took them into his house, where they had Spanish coffee, which they sipped with large spoons.

The factory was not going, as the heavy rains of the last few days had brought it to a standstill. In one respect this was convenient, as it enabled the various apparatus to be the more closely examined. The bagasse furnaces were first visited, then the factory was gone through, and finally a visit was paid to the stables where were a row of fine stallions, amongst them a splendid yellow-dun horse which was paraded for their inspection. These horses were entirely provendered with cane leaves. Dr. Herzfeld had thought beets held the advantage in this respect over canes; but he learnt that at all similar establishments the cane leaves were used down to the last scrap as fodder. No extra food is given to cattle, and these noble horses received no corn.

The men's quarters were next inspected. The married men were kept separate from the unmarried ones. The latter dwelt in a two-storied building; on the ground floor were the beds, standing on the bare ground; yet, in spite of this, the arrangements were exemplary. The married people lived in the old slave compound. In front of it stood a small house with a gateway leading through to the compound. Here lived the overseer, and the slaves used to be driven out through this gate in the morning, and back at night. Half-jokingly the guide remarked that previous to 1870, when slavery was abolished, they had such good times owing to the plentitude of labour that they wished them back again. Scarcity of labour is now a matter of frequent complaint. Considering the present small population of Cuba, immigration has not kept apace; in 1901 it amounted to 22,899 souls, in 1902 only to 11,986, but last year it increased to about 25,000, though these last figures are not official and may be in excess.

A splendid park was the next object of inspection, in which every possible tropical tree and fruit was to be found growing. It was, it may be added, the only park they saw adjoining a sugar factory. In it were to be found bananas, grape fruits, avocada pears, laurel, cinnamon, clove, apple, orange, and coffee trees; in short, everything one could imagine. It is remarkable how quickly a palm grows. One of ten years' age is as big as a pine of 60 to 80 years. In this park was a particular specimen 60 years old, which, in appearance and girth, resembled an oak several hundred years old.

During lunch some particulars of the cost of production were gleaned. The large factories produce sugar at $1\frac{1}{4}$ to $1\frac{1}{2}$ cents per lb., and the small ones at 2 cents per lb. This is equivalent in German terms to 5-9 marks per zentner. Spaniards are, it is true, prone to exaggerate; but other sober people say that the big factories can, all circumstances considered, produce sugar for 6 marks. It is therefore clear that the German cost of production will have to be still further reduced if beet sugar is to continue in the running.

Regretfully they took leave of Don Pelago and his factory. The team was once more requisitioned to take them back to the station, where they entrained for Havana. The hope kept recurring that they might eventually reach a neighbourhood where it did not rain. At Rosario for the first time no rain fell in the afternoon, so that they ventured to suppose the western part of the island would be drier; but this proved later on a delusion.

Towards 7 o'clock the party reached the terminus and boarded a ferry boat to cross to Havana. Here they witnessed "the finest harbour in the world"—there are however several of them—lit up by the rays of the setting sun. The ferry steamer passed near the wreck of the "Maine," the U.S. warship blown up in 1898 in the harbour. The Cubans desire to remove the wreckage, as being a standing danger to shipping; and they had already arranged with a New Orleans firm to carry out the task, when the Navy Department at Washington interdicted the proposal, claiming that the Maine was United States property, and could only be disposed of by an order of the Congress. Hence the wreck still lies where it sank; at high tide it is nearly covered, while at low tide it stands high out of the water. Having arrived in Havana, the party had great difficulty in finding a suitable hotel where they could make their wants understood, but finally found one in the Hotel Telegrafo. They were at first quite undeceived with regard to Havana, for the streets are narrow and their route from the harbour up to the town had the appearance of quite an insignificant place. The hotels which are all furnished with a view to protection against the heat are not so open and free as at Santiago. Stone houses with courtyards are to be seen everywhere; they are mostly narrow and dark. Consequently the heat is very excessive and proved greater than what was experienced at Santiago.

Disappointed, Dr. Herzfeld retired for the night. Next morning after breakfasting on half a pineapple, coffee with salted milk, bread and butter, he went to call at the German Consulate at 8 o'clock. Although places of business were all open by then, he found the Consulate still closed and had to call again at 11 o'clock. He paid several visits to different personages in the town that morning; and obtained information on various subjects of interest. In the evening he strolled down to the seashore. The hotel is situated in the upper town and a wonderful avenue of laurel trees leads down in five minutes to the water. This is called the Prado, and after sunset it is a scene of bustle and gaiety. Ladies were to be seen dressed in the lightest of clothes with elaborate toilettes, and would have been the delight of an artist if they had not powdered themselves to such an extraordinary extent. But the powdering has an object. It forms a protection against the mosquitoes, which would work havoc on the lightly clad persons, were they not restrained by the powder. This powdering is consequently not entirely a matter of vanity.

Dr. Herzfeld at length came to the harbour. Over its splendid entrance lay Morro Castle, the one time invincible fort, with its red and white walls rising from the water and washed by the waves. The Prado leads out into a round open space bordered by a low wall over which the sea dashes at spring tides. Hence the place is cool, and as a band stand has been erected in the centre, a regular evening concert is given. For 10 cents a seat could be procured. In the streets of Havana, it may be remarked, Spanish money is expected, but at the hotels they prefer being paid in U.S.A. currency. When one or two items of the programme had been gone through, and a third piece was being played, a woman was heard to faintly scream, "It is going to rain." Thereupon the music stopped abruptly in the middle of the piece; everybody got up silently and beat a hasty retreat; and in a minute more the piazza was empty. Nobody carries an umbrella out there, since as they say, when it once begins, the rain comes down so violently that an umbrella is of no use.

The next day was Palm Sunday. Everybody who went to service at the Cathedral was seen carrying a palm in the hands.

In the afternoon a visit was paid to the Botanical Gardens, but a thunderstorm breaking over the party, they had to drive home to the hotel. Here when they got out, a giant umbrella was held over them to keep them dry while they walked into the hotel. It is very dangerous for a traveller in Cuba to get wet. If this does happen, it is best to go to bed, as otherwise a chill, with a subsequent fever, is the result.

Next morning, Monday, there was still time for some visiting. So Dr. Herzfeld went with some business friends to see Messrs. Guma & Mejer, the well known Cubian statisticians. Snr. Mejer who was a German and spoke his mother tongue well, stated that besides the monthly report, he and his colleague produced weekly

statistics. These involved them in considerable expense, so they were prepared to dispose of them for an annual sum of 400 dollars. This sum was forthcoming from several foreign subscribers, von Licht amongst them. The latter is the only one in Germany who gets the weekly statistics. Herr Mejer was asked if the German Government could not procure these weekly figures; he answered that they could by all means if they chose to pay for them; but apparently, as it afterwards turned out, nothing was known officially about these reports. Towards the end of their conversation reference was made to the fact that last year's crop had been overestimated. Guma & Mejer, it will be remembered, at one time expected a crop of 1,500,000 tons. The excuse Mejer gave was not by all means a sound one. He said that the farmers start by fixing their crop a bit too high, because they are in want of money in the autumn. But since he knew this, he might very well have made allowance for it. Then he explained that the cane in the fields is unusually difficult to valuate. The people neither know the size of their fields, nor the process of evolution of the canes, and finally this year there had been an extraordinary drought, then considerable cold intervened, and next in April the rains had come on too early. The country with its existing factories was quite equal to working up 1,300,000 to 1,400,000 tons, for last January 100,000 tons more were dealt with than in the previous January. Meyer stated in conclusion that although he and Guma have taken the trouble to collect the statistics for a number of years, yet there is no partnership between them and they carry on business independently.

As to the quality of the canes, there were in most places no figures of analysis available.

Reference may be made once more to the fact that at Rosario the question of chemical control was discussed. Don Pelajo then expressed the opinion that no chemical control was required in Cuba such as was the case in Java. In Java there was a limit to the amount of canes, and the planters had to exert themselves to obtain the greatest possible output. In Cuba, on the other hand, an excess of cane was the rule; the chief task was to get all the canes through the factory; and there were every year a number of cane fields left uncut! This is not, however, the case this campaign; the canes have in many cases remained so backward as not to be worth cutting.

On the following Monday afternoon, Dr. Herzfeld had the pleasure of an interview with the President of the Cuban Republic. In his company, he mounted the marble steps of the palace which lies beyond the chapel erected in honour of Columbus. The latter was buried at Valladolid, Spain, in 1508, then his remains were removed first to Seville and next to San Domingo. In 1795 the bones were transferred to Havana, and in 1898 the Spaniards took them back again to Seville. Now, however, the San Domingoans allege the

bones which were taken from them to Havana were fictitious ones, and that the genuine relics are still in their possession, so that it is a matter of uncertainty as to where the great man's remains really repose.

At this juncture, it is pertinent to call attention to the remarkable change in the condition of Cuba since the cessation of Spanish rule. As long as the Spaniards were in possession, the Cubans had a national debt of 400 million dollars. This amounted to 284 dollars per head of the population, or say £60. The income was about 25,000,000 dollars per annum. Of this nearly half, viz., 10½ millions, was employed in paying interest on the Debt; 12 millions were appropriated by the Spaniards for the upkeep of their army and navy, and only 2½ millions remained to be spent in public improvements. No wonder then that no roads had been constructed since slavery was abolished. While it existed, many fine roads were made, notably the Prado in Havana.

Under the Republican Government, the total receipts by the State only amounted last year to 17½ million dollars, of which 14·7 millions were collected by taxes. The expenditure for the same period was 14,900,000 U.S. dollars or only 200,000 dollars more than the receipts from taxation. As the Americans have contrived to pay off the Spanish debt, the only outstanding debts amount to 31,600,000 dollars and these a New York firm has bought up and issued at 92. Now the stock stands at 102; interest being 5%.

An annual sum of 2½ millions is expended by the Republic on Education. However the President complained in his last Report that school attendances had decreased last year to the extent of 29,400; this he thought was a bad sign. When one considers the large number of illiterates yet remaining, one can only agree with him. Furthermore a very appreciable increase in the gendarmerie has lately taken place, and has accounted for 1,400,000 dollars. All things considered however, it would be difficult for a young and growing State to show a better financial position. It would be easy to increase the income, but such a step is not to be thought of. It is desirable to remove the tax on imported machinery, which favours the Americans, for the lower it is, the more will European machinery be able to compete with American.

The President of the Cuban Republic is a kindly old man of 70 who speaks pretty good English. He gave Dr. Herzfield half-an-hour's conversation. The latter asked him if there was any sugar factory left which it would pay to visit, but was told that owing to the rains having set in so early, all the factories had stopped working; this convinced Dr. Herzfeld that there was nothing to be gained by a longer stay in the island.

So he went to book places on the steamer for New York; but as, owing to the rainy season having set in, everybody who could was leaving the island, difficulty was encountered in getting cabins. As it was, a fairly large three-berthed cabin was eventually secured.

The last day was employed in getting their luggage booked, and seeing over a cigar factory. This belonged to the firm of H. Upmann & Co. It was situated within the town and consisted of stone buildings with well lighted and ventilated workrooms. There the party were shown how the outside and inside leaves of cigars were prepared. In Cuba the custom is to roll up whole leaves in one mass to form the contents of the cigar. These leaves are naturally sorted out by experienced hands. The covering leaves are very carefully selected; and there are two forms of cigars made. One kind with tapering points for Europe, and another for the Americans, of the same diameter throughout, so that after cutting off the end, the suction passage is as large as possible. These latter varieties are however being used in Europe too. The most expensive cigars go to Germany; neither the Americans nor English ask for them. Some samples which Dr. Herzfeld received proved too strong for his nerves. Their guide however asserted that in hot climates one could stand much stronger cigars than in Germany, and the cigars in Cuba are stronger because fresher.

Next day the party embarked for New York; the steamer was full to the last place; but the accommodation was bad. They arrived at New York a day late and after a short stay in the United States left for Germany and home, where they arrived safely, impressed with all they had seen and heard on their long travels.—(Abridged from the *Zeitschrift des Vereins der Deutschen Zuckerindustrie*).

PROGRESS IN THE ARGENTINE REPUBLIC.

The special correspondent of the *British Trade Journal*, in reporting on British trade in South America, states:—

Unfortunately French sugar machinery is running that of British manufacture very closely, especially in Brazil, where I found five out of every six sugar factories fitted with machinery made by the Fives-Lille Company, of France. In Tucuman and Concepcion (Argentina) I was gratified to find that at the large and important factory belonging to Messrs. Carlisle Brothers, and managed by Mr. Stewart Shipton, the firm are fitting up a further extensive plant, in addition to what they already possess, entirely of British make. Mr. Shipton, who took me over the works, informed me that he has always found the machinery manufactured by a first-class British firm the best to be obtained, although the merits possessed by the Fives-Lille Company, of France are not to be denied. Altogether the prospects for manufacturers of sugar machinery and refining machinery should be found very excellent at the present time, a considerable new area of cane being planted out every year, as the prices now promise to increase, in spite of the markets of Europe being shut to Argentine-grown sugar owing to the bounty stipulations in force.

LABOUR CONDITIONS OF HAWAII.

(From the annual report of the Governor of the Territory of Hawaii for 1904.)

As the sugar and rice industries of the Hawaiian Islands are the only ones employing agricultural or other labourers in large numbers, the needs of the Territory in respect to the numbers, nationality, and kinds of immigrants desired reflect to a large extent the needs of those two industries. At the present time there is, outside of the sugar and rice industries, very little room for the employment of unskilled labourers. In time to come other industries may be established which may employ a number of labourers, but there is now a necessity for only such class of labourers as can be utilized in the cane and rice fields, and in other branches of the sugar business.

The conditions which exist here render it imperative for the preservation of the industries established that labourers be brought from abroad.

Most tropical sugar-growing countries either possess an indigenous labouring population, available for the cultivation of sugar cane, or have within easy reach people who are readily obtainable for tropical field work, and whose physique and constitution enable them to undertake such field work without fear or injury to their health.

There is not such an indigenous population here to supply the demands, and the tendency of the native population is not toward field work. They make good mechanics, and a portion of these are engaged in a variety of trades, but agricultural labour appears to be distasteful to them, and the number employed on sugar estates is small. This being so, it has for many years been necessary to promote immigration of field labourers to the islands, and many countries have been drawn from. There has been regularly conducted emigration from Germany, Norway and Sweden, Azores, Madeira, Portugal, Galicia, China, Japan, and Porto Rico, besides which British, Americans, Italians, and negroes (from the United States) have come in small numbers.

Under the laws of the Kingdom and later of the Republic of Hawaii, immigration from European countries was assisted by the Government and industrial interests of Hawaii. Since annexation to the United States it has entirely ceased, as assisted immigration is prohibited by the United States immigration laws, and it is quite impossible to direct a voluntary immigration from Europe direct to Hawaii, the great distance and expense of transportation being insurmountable obstacles in the way of such voluntary immigration.

So far as the Europeans and Americans are concerned, it has, with one exception, been found that they were unfitted for tropical field work; they could not and would not perform it, and never for long

laboured as "field hands." The one exception noted is that of the Portuguese from Madeira and the Azores, who showed themselves capable of performing good field work. The improved condition of their own countries no longer necessitating immigration, these people show no disposition now to come to the islands, and even if they were willing to emigrate to Hawaii, the laws of the United States would hinder them from receiving that assistance without which immigration would be for them impossible. And here it may be stated that if other Europeans can be found who could endure labour in the cane fields of Hawaii, the immigration laws would render them unable. The geographical position of these islands and the great distances which such emigrants would have to travel would necessitate their being assisted in ways which are prohibited by the laws, as they can not themselves meet the cost. Of the Portuguese who originally came to Hawaii as assisted emigrants, those who did not go to the mainland have so prospered that now they do not engage to any large extent as plantation labourers, and their children, by the aid of the excellent Hawaiian free-school system, have fitted themselves for more congenial occupation than field labour affords.

It has sometimes been argued that the Hawaiian sugar industry is in exactly the same position as that of the Southern States, and that if the latter can supply their labour needs, Hawaii should be able to do the same. This, however, is wholly misleading and untrue. If Hawaii had a large indigenous population such as exists in the Southern States, and if Hawaii could draw upon the large streams of immigration entering the United States, from which to supply its requirements, as does that section, then such a comparison might be made. If there were no indigenous population upon which the Southern States could draw to supply the labour required in the fields, and were they wholly dependent upon Italian and other European immigration for labour, they would stand in relation to Europe geographically as does Hawaii in relation to Asia. Furthermore, while there is a stream of Italian and European immigration from which the Southern States can supply their needs, the great distance to Hawaii, coupled with the rigorous laws against assisted immigration makes it impossible for Hawaii to hope for relief from that source, even if such immigrants could stand the climate, which is far more trying than is that of the South. It must be remembered that the Hawaiian Islands are situate south of the Tropic of Cancer between the nineteenth and twenty-first degrees of longitude, consequently on or about the same level with, for instance, Vera Cruz, Manzanillo, Hong Kong, Bombay and Burmah, Cuba, Formosa, and Mexico City.

The impossibility of securing a sufficient supply of Hawaiian or other labourers able to endure the work in cane fields forced the planters of these islands into a reliance on China and Japan for the

necessary supply. The Chinese have always proved themselves to be a law-abiding, docile and industrious people, but the United States exclusion laws shut out this nationality from Hawaii as soon as annexation became an accomplished fact, and the only present practicable source of supply is Japan, though a small number have come from Korea.

Since the annexation of these islands the difficulty of maintaining an adequate supply of agricultural field labourers has been very great. Chinese are absolutely prohibited, and while the Japanese still come, the number of immigrant labourers hardly balances the number of Chinese and Japanese who return monthly to their homes, and the scarcity of labour has enchanced its value.

There exists in the minds of some, who are unfamiliar with the nature of field work in a tropical cane field, the impression that white men can perform the work, and that the proper way to conduct a sugar plantation is to divide the land into small lots and give them to white men to cultivate instead of doing the work of cultivation by day labourers working for a wage under one controlling management.

A list of the nationalities that have tried field work in Hawaii has already been given. To-day there are no white men labouring in cane fields here. Those who have tried it have never stayed by it for any length of time, and abundant evidence is forthcoming that the white men can not and will not stand the work of tropical cane fields.

Some little time ago the management of the Ewa plantation, on the island of Oahu, decided to experiment with American farmers. Fifteen families of highly respectable people were carefully selected in the Western States, and all their expenses paid to the plantation, where houses had been erected for them, each with a garden patch surrounding it, and where a large patch of "common land" had been set apart for their use as pasture for such stock as they desired to keep. Here they were given lots to cultivate in cane, and every help was rendered in the way of plowing and preparing their fields, but notwithstanding this and all the Ewa Plantation Company expended on this effort to raise cane by white farmers, these people were not able to perform the necessary labour, and they drifted away by degrees, so that in about a year none of the fifteen families was left. Other experiments of a similar nature have been made with like results.

In connection with the question of "homesteading" and of encouraging small farming, it is proper here to point out that all the lands cultivated by plantation companies, who find it necessary to irrigate because of the uncertainty of the rainfall, were either arid wastes or poor pasture lands before they were acquired by these companies, who sank artesian wells, established expensive pumping

plants, or constructed extensive water ditches and pipe lines, and at great cost poured water over the lands and made agriculture thereon a possibility. If development by homesteads only had been possible, the lands which are now cane fields would be in their primitive condition, because their irrigation was only rendered possible by the investment of a large amount of capital.

With the largely increased world production of sugar, it is only with difficulty that cane can be grown here with a profit. The remoteness of these islands from the world's market and the cost of production are factors to be contended with.

It would be of great advantage to the agricultural interests of these islands if the United States immigration laws could be so amended as to permit the assisting of a desirable class of Portuguese labourers from the Azores or neighbouring islands, or if there could be a modification of the Chinese exclusion act permitting the immigration to these islands of a limited number of Chinese agricultural labourers, such labourers to be restricted to agricultural labour and domestic service, and strictly prohibited from engaging in mechanical and mercantile pursuits; such immigration to be so regulated that the identity of each labourer may be ascertained and a record kept thereof, and that he may be required at the end of from three to five years from the date of his arrival in these islands to depart therefrom, and that such labourer be not permitted to go from these islands to the mainland. The Organic Act takes care of this now. No Chinese can go to the mainland from Hawaii.

Under the existing laws of immigration it is impossible for Hawaii to get immigrant classes from Europe or other occidental countries. Hawaii is 5000 miles from the point where the great numbers of immigrants land in the United States. Hawaiian interests have tried the experiment of bringing immigrants from Atlantic ports of the Unites States to Hawaii, and have failed. We are therefore forced to take immigrants from the Orient or go without, and to go without means the ruin of Hawaiian industries, a condition that the Congress of the United States cannot afford to permit, much less to exist, as it certainly would be making a failure of the industrial situation in Hawaii by the continued application of such a drastic measure. No class of American citizens would be injured by the special legislation above referred to, permitting a restricted immigration of field labourers from China; on the contrary, the interests of all Hawaiian citizens and producers as well as of the planters themselves would be furthered by such legislation. The population thus created would increase the Hawaiian market for American products and be for the direct interests of workmen on the Pacific coast and in all industries supplying goods to the Territory, while it would not be a competing element upon the mainland.

By the acquisition of distant territory in the Pacific Ocean the domain of the United States is extended in such a degree that in making laws existing conditions should be recognised. In matters of immigration the restrictions which are required for the protection of the mainland may be very injurious for distant possessions, and a distinction should be made by special legislation so that classes not desired on the mainland can be excluded, and the distant possessions provided for as their needs may require.—(*Planters' Monthly.*)

THE SUGAR INDUSTRY IN FIJI.

Sydney capital and enterprise have had much the largest hand in the development of Fiji, and the commercial and industrial welfare of that group of islands must become increasingly important to the merchants and shippers of this city. Sugar forms by far the largest item of Fijian production, and the bulk of this goes to the Colonial Company's refinery at Auckland; but that the balance in favour of that city is apparent rather than real is shown by the fact that practically all of the import trade of the island takes rise in and flows from Sydney.

Sugar cane can be grown upon every island of the South Seas where there is sufficient soil to give its roots a hold—the vitally essential elements of even heat and moisture are everywhere present. As a matter of fact, there is scarcely a Kanaka village from the Marquesas on the east to New Guinea on the west in which one will not find small patches of the succulent cane, cultivated both for its juice used as a beverage, and its leaves used for thatch—to keep the outside of the native dry and his inside wet. But—in the tropics particularly—between sugar-growing and successful sugar-growing there stands the almost insurmountable barrier of labour, and to the fact that Fiji has successfully solved the labour problem is due to its most creditable position in the commercial world to-day. Tahiti, to be sure, with any kind of hit-or-miss, mostly miss, labour that can be secured of a morning, does manage to keep a hundred acres or so of hillside green with cane in season; but the sugar produced, even under the stimulus of an enormous duty, is not sufficient for the consumption of her handful of people, and no steps towards putting the industry on a permanent basis dare be taken for fear that the vacillating French Colonial Office might some day be induced to remove the duty, an act that would be tantamount to reducing the fields to wastes of lantana and the mills to scrap. Fiji's success is directly due to the fair and unswerving policy of the British Government and the courage, foresight, and general good management of her planters.

Sugar raising was first established on a commercial basis in Fiji about a quarter of a century ago, the Colonial Sugar Refining Company claiming the honour of being the pioneers. The Fiji Sugar Company, the only rival of the Colonial, came into the field some years later. The first mill was a crude affair, driven by bullocks, the juice obtained being boiled to a sticky molasses in large, open iron pots. To-day the Colonial's interests in the islands run a long way into seven figures. It has over 7000 men on its pay rolls, maintains 220 miles of fixed and portable tram lines, and its mills crush cane from over 30,000 acres of land.

Owing to many severe handicaps, the industry languished during its earlier years. The ground, though rich, being newly cleared and often full of stumps, threw the exigency of tillage upon hand labour, a highly expensive and impracticable resort. The saccharinity of the cane was practically as high then as now, but the first mills, with their single sets of light rollers, were not capable of extracting over 75 or 80 per cent. of the juice content of the cane.

But field labour was the worst difficulty of all. The native Fijian, who was first requisitioned, like all the rest of the Kanakas of the islands east of the 175th parallel, loved his natural dolce far niente too well to give it up for more than a few days at a time, no matter what the wage. Tongans proved equally unsatisfactory, and the Solomon Islanders, who were next tried, though much better than their predecessors, were by no means an unqualified success as field labourers. At last the Colonial Government was induced to take a hand in the matter, and the result was the introduction of the East Indian coolie, under contract, giving to Fiji what has proved to be a more economical, uniform, and generally satisfactory system of labour than is possessed by any of her rivals.

All the work possible on the Fijian plantations, as is almost imperative in the tropics, is assigned to coloured labour. The standards of limitation as regards white and coloured labour, when it is desired to employ one—as far as possible—to the exclusion of the other, are diametrically opposite. Thus, if white labour is to be favoured, as many kinds of work are given to men of that class as they are able to stand physically; while if coloured labour has the call, men of that class are promoted as high as they are mentally efficient. The latter ruling is the existing one in Fiji, and the allotment on the Colonial Company's pay roll on that basis gives places for about 6300 East Indians and from 200 to 300 whites. These latter are principally engaged as foremen, engineers, and chemists. The more intricate of the mill machinery is also looked after by whites, and the official staff is, of course, picked from the same class.

The employment of coloured labour for field work on a sugar plantation in the tropics is a matter of necessity rather than choice. Queensland furnishes a good example. Here white hands are most

successfully employed on the more southerly plantations; but even under the stimulus of the bounty on "white" grown sugar, the amount of such produced north of the 15th parallel can practically be disregarded. With all the will in the world to work, the heat and incidental annoyances of "trashing" or "stripping" under a tropical sun are beyond the power of the ordinary white man to endure for more than a few hours at a time. The possibility of importing contract labour in Fiji, however, would in itself make the employment of white labour out of the question on the score of economy.

The field hands employed in Fiji are secured by officers in the service of the British Government, in the districts adjacent to Calcutta, in numbers to suit the demands of the planters. The Government also has charge of their shipment to Suva, where they are turned over to the sugar companies on five-year contracts, with the option of renewing same at the expiration of their time. The Sugar Company, on taking over the labourer, pays a certain sum toward the expense incident to his transportation to Fiji, which latter is very economically accomplished by means of sailing vessels. The coolies are usually brought in the ratio of two men to one woman. The usual terms of the contract provide for a wage of about 25s. a month for a man and 20s. for a woman. On piecework a man will ordinarily earn a shilling a day and a woman ninepence.

The companies provide houses for the labourers—neat, healthy, corrugated iron structures; but do not feed them. As their diet is principally rice, however, and amounts to but a few pence per month, most of their wage is clear profit. As often as pay is received the cheque is immediately cashed in Mexican or Japanese money, and the latter at once turned over to one of their own smiths to work up into silver ornaments. These they wear on all parts of their body, from nose to ankle, and the most wretched field hand may often be seen clinking about his work spangled and ringed like a Burmese prince.

The coolie has proved most satisfactory as a field hand. He is quiet, steady, reasonably quick to learn, and always willing. They are somewhat quick at a fight among themselves; but as this occurs usually at night, the routine of work is little interfered with. When the East Indian first came, there was considerable friction between him and the Fijian, but this has gradually worn off. Now the attitude of the latter is one of disdain rather than active antagonism, which feeling has worked its way into the language, the Fijian word in common use for "dog" now being "coolie."

Great improvements have been effected in the Fiji mills, and most of them have been rebuilt several times over to keep their machinery up-to-date, and the whole generally in the line of progress. The addition of two extra rollers to the three in use in the first mills, and

the substitution of the nine-roller mill for the latter, effected an approximate saving of 20 per cent. in juice extraction. More recently still twelve-roller mills have been installed, and improved chopping and shredding apparatus and hot water maceration have also cut off substantial losses.

If the methods of growing in vogue in the Fiji sugar fields were as advanced as those of milling, the industry would be an infinitely more lucrative one. As it is the acreage productions and the net profit per acre are but a fraction of those obtained in Hawaii, in spite of the fact that the planters of the latter islands pay three and four times as much for labour no more efficient than that employed by the Fijian planter. With far more surface water to draw from, and with coal much cheaper for pumping, should that be necessary, irrigation in Fiji, as compared to Hawaii, is but little practised. Nor has scientific fertilisation in Fiji been brought to the point it should have. Hence it is that her planters have had to so far content themselves with a maximum acreage production barely in excess of three tons, the value of which—say, £50—is £10 less than the average sum expended on each acre of one of the big Hawaiian plantations for fertilisation and irrigation alone. How well this latter expenditure is justified is shown by the fact that the average acreage production of the plantation in question is 10¼ tons, with a maximum production of 16 tons to the acre on the best land.

In Fiji the custom of "ratooning" (leaving the field to a volunteer growth from the old root) for a number of successive seasons—a procedure also in vogue in Queensland—is not in line with the best Hawaiian practice. There, if a "ratoon" field is not deemed capable of producing 30 tons of cane (the equivalent of 3 or 4 tons of sugar) to the acre, it is torn up, and "plant" set out. This is more expensive of course, but it has been justified by its success.

The island of Viti Levu, upon which the capital, Suva, is located, is at present the centre of the Fijian sugar industry, and there, for some time to come, the greatest progress must be looked for. There are located the three principal mills of the Colonial Company, including the huge plant at Lautoka, one of the largest mills in the world. At Labasa, on the island of Vanua, Levu, is another Colonial mill, and on this island, which is of about the same size as Viti Levu, much development will undoubtedly take place in the near future. Taviuni, the third in size of the islands, and now principally given over to fruit and copra, has also much good sugar land, and under favourable conditions may produce heavily in time.—(*Town and Country Journal.*)

Queensland's sugar crop amounted to 91,828 tons in 1903, and 147,688 tons in 1904. The 1905 crop is estimated at 162,500 tons.

THE RUSSIAN SUGAR INDUSTRY.

(Consular Report.)

The British Consul at Kieff in his Report for 1903 and 1904, has a good deal to say on the Russian Sugar Industry.

He states that "One of the direct results of Russia's abstention from the Brussels Convention is the stoppage of the export of Russian sugar to the markets of Western Europe. Notwithstanding the efforts of the Russian Government to control the production of sugar, or the laws passed to regulate the disposal of the same, as well as the fixing of the prices chargeable upon the home market, the number of factories continues to increase, and endeavours are made to increase the working capacity of existing factories. In order to dispose of the surplus production by other means than exporting it at a serious loss, the State now permits sugar under 78 per cent. polarisation to be denaturated for cattle feeding, &c., by mixing the same with bran, chaff, oats, barley or other feeding-stuffs containing not more than 10 per cent. of flour, and natually this measure dispenses with the necessity of paying the heavy excise duty of 1 r. 75 c. per pood (11s. 5d. per cwt). When it is considered that the consumption of sugar per head of population in Russia does not exceed $12\frac{2}{5}$ lbs. there would seem to be plenty of scope for increasing the consumption among the peasantry and the poorer classes of this vast Empire. It is perhaps not generally known that the producing cost ranges from 1 r. 50. per pood (9s. 6d. per cwt.) in up-to-date factories to 3 r. 15 c. per pood (£1 per cwt.) in factories of an antiquated type; a fair average gives the cost as being 2 r. 20 c. per pood. (14s. per cwt.). Then there is the excise duty of 1 r. 75 c. per pood (11s. per cwt.), which brings the factory average cost price to 3 r. 95 c. per pood (£1 5s. per cwt., or say 3d. per lb.), and, when the profit of the manufacturers and the retail dealer is added, it is safe to take the price to the Russian consumer as being 3d. per lb. for crystals and 4d. per lb. for lump sugar, prices which, so long as the present excise duty is exacted and the State controls the production and the quantity to be put upon the home market, are likely to remain in force irrespective of the quantity produced.

"The Government having sanctioned the use of spirit for illuminating, heating and other practical purposes, after it has been denaturated by the addition of foreign substances which render it unfit for human consumption, there is thereby presented a splendid opening for lamps to burn spirit instead of petroleum. Such lamps have been imported from Germany, but are not yet quite perfect. There is also a wide field open for the development of small-sized stationary engines, traction motors and motor cars using denaturated spirit as fuel. Nearly every fairly-sized estate owns its own distillery.

and as the production of rye spirit is not very costly, and no duty is charged by the Government upon it in its denaturated state, it is reasonable to expect that the landowners and farmers are anxious to make use of spirit as fuel to work their farming machinery, to illuminate their dwellings and to be the force to transport their agricultural produce to the railway station. So far as my knowledge goes, only one small-sized stationary motor of British make using spirit as fuel has been imported into this district, and has proved eminently successful. The subject is worth the attention of British firms who make a speciality of gas-forming, explosive engines, and there is no doubt that a serviceable sized spirit-driven motor, powerful enough to work ordinary grinding mills, small threshing machines, chaff-cutters, &c., would find a ready sale. Then there are the small-sized tractors for ploughing, and reaping machinery, further opening up a wide field in an industry as yet untouched in this part of Europe.

The sugar manufacturers, in view of the large stocks of sugar held over from the campaign of 1903—04, and with the desire to lessen the prospective loss on an unprofitable export trade, decided to reduce the area under beetroot in 1904 by about 14 per cent. The crop also was under average, and the percentage of sugar in the beet considerably less than that of the previous years, so that the yield was greatly under that of the previous campaign. Contrary to all expectation there was a keen demand for sugar, not only to supply the home but also foreign markets. The consequence was that the price of sugar advanced, and in order to keep it within the boundary fixed by the Minister of Finance for the home market it was found neccessary on December 1-14 to allow an extra 48,388 tons to be placed upon the home market—24,194 tons from the inviolable and an equivalent amount from the free reserve. One result of this step was to still further raise the price of beet sugar upon the markets of Europe, the presumption being that the Russian supply was thereby shown to be unable to meet the demand; and this increase in price made all the difference to the Russian sugar exported, turning the loss hitherto pertaining to the export trade into a profit; and it is not to be wondered at if Russian-made sugar, nothwithstanding the ruling of the Brussels Convention, found its way to the markets of Europe. The price of export sugar, which in July, 1904, was 9s. 4d. per cwt., rose to 12s. 8d. per cwt. in December (in July, 1903, it was only 6s. 6d. per cwt.), with the result that the large stock from the campaign of 1903—04 was cleared out, and it is possible that the inviolable reserve will have to be still further drawn upon in order to supply the home market. In fact many of the manufacturers have sold more sugar for "export future delivery" than they are likely to be able to supply, so that there is little likelihood of there being any stock available from the coming campaign. The result will, therefore, most likely be a large increase in the area under beetroot in 1906, so

as to ensure a sufficient quantity of sugar to supply the requirements of the home market and to build up a certain reserve.

The campaign of 1904-05, with 276 factories in operation, showed a production of sugar of 838,728 tons—there may be a slight variation when the final returns are made up—or 315,572 tons less than the previous campaign of 1903-04. The following quantity was given as being in stock from that campaign, viz.:—

	Quantity. Tons.
Free reserve—	
Finished sugar..	257,102
Products calculated as white crystals	35,743
Inviolable reserve	95,638
Total	388,483

Thus there is shown an available supply of 1,227,211 tons, and of this quantity 774,194 tons are destined for the supply of the home market, 96,774 tons to form the inviolable reserve, and 356,243 tons a free reserve available for export, or to be held over to form the part of the production of the campaign of 1905-06 under the conditions explained in my previous report.

The area under beetroot in 1904 was 1,204,937 acres, but as 21,621 acres gave no result, the actual yielding area was 1,183,316 acres, or a reduction, when compared with 1903, of 164,239 acres. The yield of roots was 6,388,742 tons (108 cwts. to the acre), a decrease, when compared with 1903, of 1,199,241 tons. When it is kept in view that the area in 1903 was 95,835 acres less than in 1902, we get a total reduction of area in two seasons of 260,074 acres, with a reduction in the yield of roots of 2,243,048 tons.

Table showing area and yield of beetroot, the yield of sugar from roots, and the number of factories during the year 1904:—

	Area in 1,000 Acres.	Yield in 1,000 Tons.	Yield of Sugar from Roots in 1,000 Tons.	Number of Factories.
Kieff	330	1,727	218	75
Volhynia	65	361	51	16
Podolia	246	1,368	169	51
Bessarabia	2	14	2	1
Kherson	16	39	6	2
Kursk	127	728	99	21
Poltava	22	89	12	5
Kharkof	126	812	117	27
Chernigof	51	300	41	13
Five provinces in Central Russia	57	257	31	16
Nine provinces in Poland	141	694	93	49
Total	1,183	6,389	839	276

The average cash price upon the Kieff market for white crystals for the home market was £1 7s. 10d. per cwt. during the first eight months of the year and £1 7s. 4d. per cwt. during the latter four months, with delivery at the nearest railway station. The boundary prices fixed by the Minister of Finance for the above periods were £1 8s. 5d. and £1 7s. 5d. per cwt. respectively, and only in two instances, viz., during the last week of November and the first week of December, did the price exceed the limit fixed.

The quantity of sugar supplied in 1904 for consumption in Russia was 752,249 tons, made up of 513,498 tons of refined and 238,751 tons of soft sugar. This shows an increase of 30,462 tons when compared with 1903, and 55,129 tons in conparison with 1902.

The quantity of sugar exported by Russia in 1904 is given by the Russian Association of Sugar Manufacturers as 170,243 tons as against 236,673 tons in 1903 and 128,901 tons in 1902. The following figures gives the quantity exported to different countries :—

Country.	Quantity. 1904. Tons.	Quantity. 1903. Tons.
Finland	34,421	97,823
Persia	51,685	63,575
Turkey	51,554	30,412
China	5,061	1,050
Afghanistan	315	530
Other countries	302	239
Germany and Austria-Hungary, in transit	26,905	43,044
Total	170,243	236,673

In commenting on the decline in the exports of 1904 the above association ascribe it to the reduction in the production of sugar in conjunction with the law which came into force on May 12-25, 1903, and fully referred to on page 27. The association again draw attention to the fact that the Brussels Convention is responsible for the decline in the export of Russian sugar to the countries of Western Europe; and, if in the face of this restriction 26,905 tons found its way to European countries, this is entirely due to the quantity of Russian sugar sent to Austria-Hungary and Germany in transit,. and, in the case of Germany, shipped to the markets of the East as the product of that country. The increase in the export to China is given as being due to the presence of the Russian Army in Manchuria. The increase in the trade with Turkey, notwithstanding the strong competition of the sugar-producing countries of Europe, and particularly of Austria-Hungary, is worthy of attention, and is no doubt greatly due to the possibilities of shipment from Odessa.

As a considerable misconception seemed to prevail in the United Kingdom during the latter months of 1904 as to the reason for the

sharp and unexpected rise in the price of beet sugar, it may be worth while quoting the figures given by the Russian Association of Sugar Manufacturers of the areas under beetroot and the production of sugar from the same for the years 1903 and 1904 in those countries of Europe which, prior to the Brussels Convention, were responsible for the enormous over-production of beetroot sugar:—

Country.	Area under Cultivation in 1,000 Acres. 1903.	1904.	Production of Sugar in 1,000 Tons. 1903.	1904.
Germany	1,047	1,036	1,708	1,350
Austria-Hungary	778	808	1,026	798
France	590	476	703	529
Russia	1,348	1,183	1,016	839
Belgium	149	113	180	152
Other countries	296	274	365	303
Total	4,208	3,890	4,998	3,971

In comparing these figures it is interesting to know that while in 1904 the reduction in the area under cultivation was only 318,000 acres, or 7·55 per cent., the reduction in the production of sugar was 1,027,000 tons, or 20·5 per cent., so that the reduction in the area could not alone be accepted as the reason for the shortage in sugar, but rather the failure of the crop and the poor quality of the root.

GERMANY.

Results of the Campaign of 1904-05.

The number of factories at work during the season which has just closed was only 375, as compared with 384 in 1903-04 and 390 in 1902-03.

The area planted with beets was 414,802 hectares, as compared with 416,897 during the preceding season.

The quantity of beets worked up amounted to 10,080,538 metric tons, against 12,677,099 metric tons in 1903-04 and 11,255,958 metric tons in 1902-03. The yield per hectare was 243 dz., against 304 dz. in 1903-04. This is the lowest yield since the crop of 1874-75, when only 206 dz. were obtained.

The sugar production in raw sugar value, including the sugar extracted from molasses, was:

1904-05. Metric Tons.	1903-04. Metric Tons.	1902-03. Metric Tons.
1,350,226	1,650,980	1,628,810

The yield obtained was 14·88 per cent., against 14·38 per cent. in 1903-04, 14·47 in 1902-03, and 13·63 per cent. in 1901-02.

The exports in raw sugar equivalent have been:

1904-05. Metric Tons.	1903-04. Metric Tons.	1902-03. Metric Tons.
763,555	873,623	1,010,659

CONSULAR REPORTS.

ROUMANIA.

At present there are five sugar refineries in Roumania, viz., Roman, Marasesti, Chitila, Ripiceno (Botosani), Sâscut, and their annual output is said to be from 18,000 to 20,000 tons. About 75 per cent. of the sugar is cubes and the remainder crushed and in loaves. The labour employed on the beet-fields is mostly foreign, a large percentage being Hungarian. The men receive 1 fr. 50 c. to to 1 fr. 60 c. per day, and the girls employed in cutting up beet receive 70 to 80 c.

In order to protect the present refineries the Government have decided to grant no further licenses for new enterprises.

The beet crop for 1904 equalled only about two-thirds of that for 1903. A comparative table shows the figures to be:—

Year.	Quantity.	Year.	Quantity.
1900	236,580	1903	208,480
1901	254,780	1904	145,090
1902	130,830		

AUSTRIA-HUNGARY.

The number of mills working in Bohemia in 1903-04 was 127, which produced 562,528 tons of raw sugar from 3,620,000 tons of beetroot, as against the same number of mills producing 440,225 tons from 2,860,000 tons of beetroot for the preceding campaign of 1902-03.

The sugar exports from Austria-Hungary to the United Kingdom were in 1904:—

	Tons.
Raw Sugar	38,705
Refined Sugar	198,402

The value of the sugar exported to India was:—

1903. £	1904. £
230,540	1,156,620

The percentage of sugar contained in the beet was:—

In—	1903-04. Per cent.	1902-03. Per cent.
Bohemia	15·5	15·3
Austria	14·9	14·8

There were 236,652 tons of molasses produced in Austria-Hungary in 1903-04, of which 109,274 tons were produced in Bohemia. 172,553 tons were used in the distilleries, and the export was nil.

ITALY.

The British Consul-General reports as follows:—

As was anticipated in a former report, the production of sugar in Italy has continued to increase largely, resulting in a considerable loss to the customs on the duties on imported sugar. There are now

34 factories in Italy for the production of the article, of which the most important produces 61,309 quintals annually. The total output of Italy for the year 1903-04 is 1,308,606 quintals, or 354,515 quintals more than in 1902-03. The supply is, in fact, greater than the demand, and there are considerable stocks standing over.

The duty on the home-grown sugar produced 64,115,000 lire in 1902-03 in contrast to 52,558,000 lire in 1903-04, a loss to the revenue of 11,557,000 lire (£462,280).

This loss, however, is due in part to the new methods of collection of the duty. Formerly the duties were paid at fixed and frequent periods, now they are collected when the sugar is sent out for consumption. For example, on the old system the whole tax on the sugar produced (1,308,606 quintals) that is to say, 88,973,246 lire, would have been levied and would have figured to the credit of the revenue, but by the new system as only 782,107 quintals were issued to consumers, the tax received amounted only to 52,558,000 lire.

The importation of foreign sugar is reduced to a negligible quantity, and has been falling steadily for the last four years. Thus we have:—

Year.	Quantity. Quintals.
1900	552,559
1901	371,895
1902	200,095
1903	52,678
1904	4,599

FORMOSA.

The British Consul at Tainan writes:—

In view of the increased number of sugar mills now being erected there will soon be a regular trade in mill stores.

The following remarks, which have been furnished by an Englishman of great practical experience in the working of rice and sugar mills, and who is fully acquainted with the respective merits and demerits of both British and American machinery catalogues, may prove worthy of note by those interested in the subject:—

"In many instances British machinery catalogues are evidently issued only for the use of practical engineers, or for persons having a high technical knowledge, and do not compare favourably with American catalogues, which cater for farmers, contain much fuller and simpler details, and are easier of comprehension by the lay mind.

"It seems desirable that British machinery manufacturers should endeavour to improve their catalogues in a way calculated to remedy this defect and to adapt them to meet two conditions:—

"Firstly, for new markets like Formosa (or, perhaps, even like China) where machinery is but rarely employed. That is to say, for

districts where the essential points to be considered are moderate prices and simplicity of construction and design, and where too many technicalities are to be deprecated on account of a possible lack of technical knowledge on the part of buyers.

"Secondly, catalogues for advanced markets, which should contain full technical details of highly finished or expensive machinery for the use of practical engineers and persons acquainted with the technicalities of machinery."

It seems desirable to refer to the fact that many commercial inquiries arrive at this Consulate addressed "British Consul, Tainan, Formosa, China." The correct address is, however, "British Consul, Anping, South Formosa, Japan." The official designation of the Consul is "British Consul for the District of Tainan," but, as a matter of fact, the Consulate itself is situated at Anping, three miles from Tainan. Care in using the above form of address will probably save delay in transmission in many cases.

Angola.

In spite of the bounties granted to planters of 50 per cent. rebate on the import duty in Lisbon, the sugar industry has been but little developed. Those who laid down sugar plant at a considerable cost still devote the greater part of their energies to distilling, rum having been in increased demand of late. No sugar was exported in 1904.

PUBLICATIONS RECEIVED.

Verlustbestimmung und Betriebskontrolle (The Determination of Loss and Control of Working), by Dr. P. Herrmann. Schallehn and Wollbrueck, Magdeburg, 1905; 434 pages and 72 illustrations. Mk. 15.

It was a happy idea of the author to publish this book at the present time, when the losses in the manufacture of beet sugar are being continually discussed in the different sugar papers and at the meetings of the different Sugar Societies. The author, who is a chemist and assistant manager of one of the best-managed beet sugar factories in Germany, gives in this work his own experience as well as the opinions of the different experts in the beet sugar growing countries. His book reveals a careful sifting, collecting, and criticising of the different data relating to the determination of losses, and is of its kind the only one dealing exhaustively with this important subject. In general, by its carefully compiled tables, comparative statements, and useful illustrations, finally by its clear language, it serves an urgent want, and should not be missed in the library of a beet sugar manufacturer or chemist. There is a

preface by Dr. H. Claassen, who himself states that the chemical control and the determination of the losses in a beet sugar factory are amongst the most difficult duties of the works chemist. Included in this book we find the results of Pellet, Sachs, and Weisberg dealing with the same subject, as well as the resolutions of the International Congress of Applied Chemistry. As quite recently Austrian experts surprised the world with their statements that the undeterminable losses are much higher than one had or could have imagined before, that the whole analysis of the sugar beet is faulty from beginning to end, and that the hidden losses amount to 1·5 to 2%, Dr. Herrmann gives his readers the whole controversy. He rightly pleads in several places for uniformity of the methods of analysis.

But the statements (page 132) relating to the destruction of sugar by lime are contrary to our experience, as we found that lime in excess in a hot sugar solution had a destructive property. This was confirmed by several American chemists we met in America but a short while ago. We also find that great losses occur in the heating, evaporation, and boiling of sugar solutions, hence the author might have omitted (page 144) the statement that normal sugar liquors do not suffer any loss in boiling. Again, we must question the assertion that a content of C O in the saturation gas causes a bad saturation and filtration. In conclusion, we might remark that Tables 39, 40, 41 (forms for analysis and control books) should be adopted in all sugar factories. S. S.

LISTE GÉNÉRALE DES FABRIQUES DE SUCRE. 37th year of publication. Campaign 1905-06. Paris: Bureau du *Journal des Fabricants de Sucre*, 160, Boulevarde de Magenta.

We have often had occasion, in previous years, to mention this annual, which contains particulars of the refineries in existence not only in France but in practically all the countries of the world. We hope, however, its accuracy is not to be judged by the particulars given in the British section. Why are Messrs. Neill, Dempster & Neill, of Greenock, and The Bristol Refinery, of Bristol, returned as "Inactive"? The former have been continuously at work since the Brussels Convention came into force, save for an occasional stoppage for repairs; and the Bristol Refinery has been in active work since July, 1904. Is our contemporary oblivious of the fact that since the bounties have been abolished, British refineries have had every inducement to keep going?

FUEL ECONOMY IN SUGAR FACTORIES, by Samuel L, Jodidi, Ph.D. Beet Sugar Gazette Co., Chicago. Paper: 27 pp., 50 cents.

This is a reprint from the *American Sugar Industry and Beet Sugar Gazette*, and will doubtless be found of value to engineers in charge of factories.

Correspondence.

THE COST OF PRODUCTION IN JAVA.

TO THE EDITOR OF "THE INTERNATIONAL SUGAR JOURNAL."

Sir,—In reply to your enquiry whether it would have been possible for Java to continue producing sugar at prices such as ruled in 1902 and 1903, before the effects of the Brussels Convention on the Cartel bounties had become patent, I beg to refer you to the figures for the cost price of sugar recorded in your Journal on pages 340 and 341 of the year 1904.

Mr. Engelberts has computed the cost price of the sugar delivered by 111 sugar estates, where he could guarantee the accuracy of the figures for every item. He calculated as an average the cost price of Java sugar in the year 1900 at £7 10s. 5d. per metric ton, including all charges of management, agriculture, manufacture, carriage to the coast, upkeep of factory and buildings, interest on the floating capital and commissions. This does not include new machinery required for increasing the capacity, nor new transport material, nor the interest and sinking fund of the capital invested in the sugar house and appliances.

He calculates the average cost of interest and sinking fund at £1 1s. 9d. per ton, making the average prime cost for the sugar in the season 1901-02 £8 12s. 2d. per ton.

Mr. s'Jacob calculated the cost price of sugar for the year 1902 for an average of 42 estates at £7 5s. 11½d. per ton, including everything save interest on capital and sinking fund, bringing up the total cost price per ton to £8 7s. 8½d.

The price of sugar here during the last few years has been as follows:—

	£	s.	d.		£	s.	d.
1902	6	16	7	1904..	8	3	9
1903	7	5	3	1905	9	10	6

This is the net price, coming into the hands of the mill-owners. When we compare the price which the Java sugar fetched with that which it has cost to produce, it is evident that we could not go on much longer losing money on sugar.

The cost price is an average figure; some estates make their sugar cheaper, while others spend more money on it; so that even in 1902 some estates still made a profit, and of course these would have remained even if the price had maintained itself at the very low level of that year, but the majority of the estates lost money in the years 1902 and 1903, and would have been ruined if the price had not gone up to a more normal height.

I am sure that if the state of things had not been altered by the Brussels Convention, the Java sugar industry would have shared the fate of every other cane sugar industry of the world; that is to say that it would not have prospered, but would have had to use every effort to make both ends meet.

Yours truly,

H. C. Prinsen Geerligs.

Pekalongan,
18th August, 1905.

FIVE-ROLLER MILLS.

To the Editor of "The International Sugar Journal."

Sir,—The interesting and instructive letters that have appeared in your valuable journal on this subject naturally suggest the question as to what it is that Mr. J. McNeil considers worthy of being put on record regarding his firm's connection with the Five-Roller Mill. The correspondence shews that neither the original design nor the credit of having introduced the first Mill belongs to his firm.

I venture to inform your few readers, who are not aware of the fact, that the Five-Roller Mill has already served its day and generation. It was a step in the right direction a quarter of a century ago, but it never secured adoption to an extent comparable with other preparatory devices of greater efficiency, or more effective methods of juice extraction. This is common knowledge, and is its experience in every country into which it has been introduced including its birthplace Campos. The fact that its design calls for an elaborate description at the present day is the best object-lesson of this truth.

I am, &c.,

"Demerara."

MONTHLY LIST OF PATENTS.

Communicated by Mr. W. P. Thompson, C.E., F.C.S., M.I.M.E., Chartered Patent Agent, 6, Lord Street, Liverpool; and 322, High Holborn, London.

ENGLISH.—Application.

17554. C. H. Bertels, London. *Improvements in or connected with processes for the purification of sugar juices.* 30th August, 1905.

Abridgements.

3827. J. Robin-Langlois, Paris, France. *Improvements in and relating to machines for the manufacture of sugar.* 23rd February,

1905. This invention relates to a machine for delivering small slabs of sugar after being moulded and cut, comprising a continuously moving endless chain conveyor adapted to receive and discharge the said slabs of sugar.

1629. J. W. MACFARLANE, Glasgow, N.B. *Improvements in steam superheating apparatus for use with centrifugal machines for sugar.* 27th January, 1905. This invention relates to a steam superheater and superheat maintaining apparatus, comprising in combination a superheating casing, a steam drying chamber communicating therewith, a pressure reducing valve between the chamber and a low pressure steam superheating device within the casing and a low pressure steam pipe communicating with the heating device and within the high pressure steam pipe.

GERMAN.—ABRIDGMENT.

162392. GUSTAV HILLEBRAND, of Werdohl, Westphalia. *A shreddings knife having a support arm formed on the under side as a cylindrical surface.* February 3rd, 1905. (Patent of Addition to Patent No. 160936 of December 2nd, 1903.) This is a modification of the shreddings knife described in Patent No. 160936 and its characteristic feature is that a bar inserted in the upper hollow side of the knife support arm is divided longitudinally, that is to say consists of two halves each provided with a screw. In a further modification of the shreddings knife described each half of the bar and its screw is formed in one piece.

NOTE.—Copies of all published specifications with their drawings in these lists can be obtained from W. P. Thompson & Co., 6, Lord Street, Liverpool, at One Shilling a copy for English or American Patents, and Two Shillings for German. In ordering please give number and date.

IMPORTS AND EXPORTS OF SUGAR (UNITED KINGDOM)

To end of August, 1904 and 1905.

IMPORTS.

Raw Sugars.	Quantities. 1904. Cwts.	1905. Cwts.	Values. 1904. £	1905. £
Germany	4,524,776	2,987,955	2,030,563	1,823,004
Holland	184,273	86,601	88,658	61,413
Belgium	282,453	298,667	126,025	218,321
France	268,227	220,806	134,226	146,418
Austria-Hungary	683,106	367,026	307,428	242,116
Java	1,401,544	1,891,956	618,432	1,301,387
Philippine Islands	86,650	9,680	31,025	4,840
Cuba	....	....	....	....
Peru	703,004	860,473	324,567	589,565
Brazil	82,317	77,900	31,176	42,765
Argentine Republic	....	....	....	....
Mauritius	378,275	158,460	139,781	87,369
British East Indies	186,986	412,492	75,501	227,605
Br. W. Indies, Guiana, &c.	809,929	873,126	523,700	710,971
Other Countries	410,395	668,807	189,489	464,038
Total Raw Sugars	10,001,935	8,914,949	4,620,571	5,919,812
Refined Sugars.				
Germany	7,675,077	6,879,389	4,328,819	5,548,267
Holland	2,167,169	964,111	1,289,119	820,194
Belgium	315,328	163,729	180,722	138,774
France	1,689,593	1,080,318	937,102	847,103
Other Countries	168,866	344,219	89,421	281,944
Total Refined Sugars	12,016,033	9,431,846	6,825,183	7,636,282
Molasses	1,119,142	1,584,652	210,270	319,142
Total Imports	23,127,110	19,931,447	11,656,024	13,875,236

EXPORTS.

British Refined Sugars.	Cwts.	Cwts.	£	£
Sweden	2,467	184	982	168
Norway	18,810	14,394	10,049	11,158
Denmark	80,065	57,170	40,489	41,821
Holland	40,899	51,861	21,581	40,870
Belgium	7,520	5,031	4,025	3,508
Portugal, Azores, &c.	10,439	9,987	5,559	7,477
Italy	2,888	2,643	1,341	1,817
Other Countries	230,126	192,090	146,659	173,880
	393,214	333,360	230,685	280,699
Foreign & Colonial Sugars.				
Refined and Candy	18,032	14,474	12,381	13,326
Unrefined	76,613	53,748	42,681	39,529
Molasses	1,657	2,708	930	823
Total Exports	489,566	404,290	286,677	334,377

UNITED STATES.

(Willett & Gray, &c.)

(Tons of 2,240 lbs.)	1905. Tons.		1904. Tons.
Total Receipts, Jan. 1st to Sept. 14th ..	1,364,190	..	1,404,853
Receipts of Refined ,, ,, ,, ..	748	..	414
Deliveries ,, ,, ,, ..	1,306,062	..	1,405,586
Consumption (4 Ports, Exports deducted) since January 1st	1,246,365	..	1,316,962
Importers' Stocks September 13th ..	58,128	..	11,428
Total Stocks, September 20th	181,000	..	148,462
Stocks in Cuba, ,, ...	178,000	..	14,857
	1904.		1903.
Total Consumption for twelve months ..	2,727,162	..	2,549,643

CUBA.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1904 AND 1905.

(Tons of 2,240lbs.)	1904. Tons.		1905. Tons.
Exports	966,499	..	789,213
Stocks	115,198	..	290,438
	1,081,697	..	1,079,651
Local Consumption (seven months)	24,360	..	25,260
	1,106,057	..	1,104,911
Stock on 1st January (old crop)	94,835	..	—
Receipts at Ports up to July 31st	1,011,222	..	1,104,911

Havana, 31st July, 1905. J. GUMA.—F. MEJER.

UNITED KINGDOM.

STATEMENT OF IMPORTS, EXPORTS, AND CONSUMPTION FOR EIGHT MONTHS ENDING AUGUST 31ST.

SUGAR.	IMPORTS. 1903. Tons.	1904. Tons.	1905. Tons.	EXPORTS (Foreign). 1903. Tons.	1904. Tons.	1905. Tons.
Refined	690,036	600,802	471,592	1,594	902	724
Raw	428,929	500,097	445,747	2,133	3,831	2,687
Molasses	51,150	55,957	79,232	63	83	135
Total	1,170,115	1,156,856	996,571	3,790	4,816	3,546

	HOME CONSUMPTION. 1903. Tons.	1904. Tons.	1905. Tons.
Refined	634,025	610,936	472,564
Refined (in Bond) in the United Kingdom	—	343,200	350,256
Raw	387,679	86,988	69,207
Molasses	41,281	53,270	74,609
Molasses, manufactured (in Bond) in U.K.	—	39,460	34,734
Total	1,062,985	1,133,854	1,001,370
Less Exports of British Refined	31,411	19,661	16,668
Total Home Consumption of Sugar	1,031.574	1,114,193	984,702

STOCKS OF SUGAR IN EUROPE AT UNEVEN DATES, SEPT. 1ST TO 20TH, COMPARED WITH PREVIOUS YEARS.

IN THOUSANDS OF TONS, TO THE NEAREST THOUSAND.

Great Britain.	Germany including Hamburg.	France.	Austria.	Holland and Belgium.	TOTAL 1905.
141	183	314	72	39	748

	1904.		1903.		1902.		1901.
Totals	1104	..	1474	..	1467	..	620

TWELVE MONTHS' CONSUMPTION OF SUGAR IN EUROPE FOR THREE YEARS, ENDING AUGUST 31ST, IN THOUSANDS OF TONS.

(Licht's Circular.)

Great Britain.	Germany.	France.	Austria.	Holland, Belgium, &c.	Total 1904-5.	Total 1903-4.	Total 1902-3.
1598	973	613	450	173	3806	4365	3393

ESTIMATED CROP OF BEETROOT SUGAR ON THE CONTINENT OF EUROPE FOR THE CURRENT CAMPAIGN, COMPARED WITH THE ACTUAL CROP OF THE THREE PREVIOUS CAMPAIGNS.

(From Licht's Monthly Circular.)

	1904-1905.	1903-1904.	1902-1903.	1901-1902.
	Tons.	Tons.	Tons.	Tons.
Germany	1,595,100	1,927,681	1,762,461	2,304,923
Austria	889,400	1,167,959	1,057,692	1,301,549
France	622,100	804,308	833,210	1,123,533
Russia	950,000	1,206,907	1,256,311	1,098,983
Belgium	173,800	203,446	224,090	334,960
Holland	136,500	123,551	102,411	203,172
Other Countries .	340,000	441,116	325,082	393,236
	4,706,900	5,874,968	5,561,257	6,760,356

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☞ The Editor is not responsible for statements or opinions contained in articles which are signed, or the source of which is named.

NOTES AND COMMENTS.

Exports from British Guiana from 1st. January to September 29th, 1905:—Sugar, 41,958 tons; Rum 971,269 gallons; Molasses, 2,024 casks; Cattle food and Molascuit 3,737½ tons; against 48,817 tons; 1,313,146 gallons; 1,535 casks; and 3,082 tons respectively for the corresponding period of last year.

The Brussels Permanent Commission.

The Brussels Permanent Sugar Commission met for its Autumn Session on October 23rd. The sitting only lasted a few days and the chief matter considered is said to have been the attitude of the Brazilian Government. Sir Henry Bergne and Mr. George Martineau, C.B. were the British delegates.

British Guiana.

The returns of estate-trials of different varieties of canes for the crop April-June, 1905, published by the Department of Science and Agriculture, have given the following results:—The first place is taken by B208, D625 now falling to the second place. Last on the list are the Bourbon and White Transparent, and intermediate between these extremes are D145, D74, D109, Sealy, B109, B147. The crop in question was growing during a period of drought, and the results have, therefore, a special interest.

The Sugar Season, 1904-05.

The *Times Financial Supplement* of October 9th contained a couple of good articles on *the 1904-05 Sugar Season*, and *the Scotch Sugar Refining Industry* respectively. Dealing with the former, it remarked that the year 1904-05 has been a record of extravagant speculation, of fluctuations in prices rarely exceeded in extent, and, in its closing days, of heavy failures. There have been few years in which such violent movements have taken place, and none since 1888-1889, when prices rose from 12s. 6d. to 28s. 3d., and fell again to 11s. 3d. There was at first little to suggest an approaching crisis, but when estimates were put forward by the leading authorities pointing to a shortage of production of from 1,200,000 to 1,500,000 tons, due chiefly to the drought, the upward rush of prices began. 88% beet quoted at the beginning of October last year at 11s. 3½d. per cwt., had risen to 16s. 6¼d. in January, while West Indian Crystallized rose during the same period from 18s. 9d. to 25s. 3d. These were the highest points reached in the twelve months. Since then, with an occasional rally, the trend of prices has been steadily downwards till September 30, the close of the year, when beet was quoted for May delivery at 9s. 1d. per cwt. Dealing with the shortage of the beet crop, the writer deems that the primary cause of the great advance in prices during the early months of the past campaign—namely, estimates of a short beet crop—has really been to a great extent justified by the ultimate yield, and had other factors been of a normal character, the speculative element responsible for the rise might have won their battle. But estimates altogether miscalculated the consumption. Owing to the general rise in prices, consumption, following a well-recognised law, shrank accordingly, and to a greater extent than had been anticipated. For the first 11 months of 1904-05, consumption shows a falling off of 856,598 tons, as compared with the same period of 1903-04. The article concludes with the following words: "We have said nothing "about the Brussels Convention for two reasons. First, because the "market movements have been mainly influenced by causes which "must have operated, Convention or no Convention. Secondly, "because the 1903-4 season followed too closely upon the date when "the Convention became effective, and the 1904-5 season has been of "too exceptional a character to admit of a fair, unbiassed judgment. "Neither season has contributed knowledge enough to fulfil the hopes "of the friends of the Convention, nor to justify the denunciations of "its enemies."

The Scotch refining industry is now in a much more promising condition than it has been for a long time. Probably none of the British refining districts will benefit more from the effects of the Brussels Convention than Scotland. There sugar refining is an old industry, and at one time was carried on at Greenock, Glasgow, Leith, Dundee and Aberdeen, though now it is confined to Greenock

alone. The latter is at present a good third on the list of British importing and refining districts. Its conditions are moreover peculiar in that it is specially and preferably Colonial. Greenock has always preferred to refine British-Colonial cane sugar, though it has been compelled to fall back also on European beet sugar. There is now less beet refined than before the Convention, and next year there will be less still.

In the seventies the total output was about 6,000 tons per week for a dozen refineries; the present production is 3750 tons per week for six refineries, but the producing capacity of the latter is fully 4000 tons per week. Greenock has always preferred West Indian sugar. In London on the other hand practically all the refining is of beet sugar, while in Liverpool both beet and cane are treated, the cane being for the most part imported from South America. The following statement shows the change which is taking place in the Greenock imports:—

Eight Months' Imports of Raw Sugar into the Clyde.

	1905. Tons.	1904. Tons.
Total cane	60,772	55,788
,, beet	21,238	42,231
	82,010	98,019

A large increase is expected this year in the crop of West Indian cane sugar, more of which will go to the Greenock refineries. Moreover, as Canada is not able to refine all the sugar she requires, some of her West Indian raw sugar will go to Greenock to be refined, and then be shipped to Canada, still under the preferential tariff.

Java and the Brussels Convention.

A writer in a Liverpool paper points out as further evidence of the fact that Java has benefited by the abolition of bounties, that the exports of sugar from that country to the United Kingdom during the fifteen years ending 1897 showed a steady decline. Here are the figures for some of the years:—

	£		£
1883	4,091,013	1895	874,313
1886	3,162,478	1896	752,234
1889	2,234,174	1897	322,309
1892	1,553,167		

But as the final turn of the screw was given by bounties and cartels in 1902, it is as well to see what the figures for the years 1898—1905 have been:—

	Cwts.	£
1898	562,845	279,348
1899	149,732	86,921
1900	163,684	88,964
1901	208,975	86,771
1902	Nil.	Nil.
1903	544,421	262,171
1904	1,877,510	917,478
1905 (9 months)	1,928,466	1,316,260

These last figures show very clearly the effects of the influence exerted by the bounties and cartels in their last years of activity. Supplies have fluctuated a bit, but there was as a whole a distinct decrease till in the year 1902, when the record low price of 6s. was reached, the imports were *nil!* But this same year saw the successful meeting of the Brussels Conference, to be followed by the Sugar Convention which came into force in September, 1903. Thereupon imports from Java increased with almost phenomenal rapidity, till ere two years were past the figures of ten or twelve years ago were exceeded. We thus find that the amount for the first nine months of 1905 exceeds that of the whole of 1904.

These figures surely speak volumes. They make it plain that the present régime of fair trade is the one most likely to ensure an unlimited supply of good cane sugar reaching the United Kingdom from various parts of the world. We are no longer in danger of being limited to Continental beet sugar to supply our markets. Java, Peru, the West and East Indies, and possibly ere long Cuba, will all be drawn on. Yet in spite of all this progress, there are men in this country engaged in a political campaign against the system which has given us this larger source of supply. The Confectioners' Alliance and their organ, *The Sugar Users' Journal*, never cease to decry the Brussels Convention. It is the source of all their ills, to judge from what they allege against it; we have, however shown that the main result has been all in their favour, viz., the considerable increase in the sources of supply. And we may as well tell them that there is no fear of the old *status quo* returning. Whatever a Radical Government in this country may desire, it is beyond question that foreign Governments, having got rid of the incubus of bounties, will never consent to their re-installation. They have learnt that a country as a whole is the better without them. We counsel Mr. Boyd and his friends to confine their attention to getting the sugar tax repealed, and to leave the Brussels Convention alone. They would then be standing on firmer ground.

Canadian Enterprise in Fiji.

We learn that a British Columbia refining firm have bought an old sugar estate in Fiji, which they propose to extend. For this purpose

the factory has had to be reorganized; and accordingly an order has just been placed with Messrs. the Mirrlees Watson Co., Ld., of Glasgow, for an entirely new plant. This comprises a 9-roller, 32 in. × 66 in. mill, a quadruple evaporator, having 10,000 square feet of heating surface, correspondingly large vacuum pans, central condensation plant, defecating plant, water tube boilers with forced draught, and, in short, the whole of the equipment necessary to turn out a very large amount of sugar. This indeed is stated to be the largest individual order that has been placed in this country for sugar machinery for many years past.

This new scheme of Canadian refiners of drawing on new supplies of cane sugar opens up the question of the supply of West Indian sugar to Canada. Just now when proposals of federating the West Indies to Canada are being mooted in the papers, it is a little strange to find the buyers of the West Indian staple crop evolving new sources of supply although they have not by any means exhausted the old one. We fear that when it suits Canada's pockets better, she will have no scruples about changing her sources of supply. The best policy the West Indies can adopt is one which shall endeavour to secure markets all over the British Empire, and refuse to be bound to any one colony by preferential ties which may ultimately prove a delusion and a snare. They will then not be so seriously affected by the loss of a market or two.

Are West Indian Affairs Improving?

Our excellent contemporary, the *West India Committee Circular*, has the following in a recent issue:—"In the Produce Markets' Summary in our present issue, we give a table showing the average prices of 88 % beet sugar for each of the last ten years. The average for the whole of this period was 9s. $5\frac{3}{4}$d. per cwt., and considering that the present quotation is as low as 8s. $8\frac{3}{4}$d., it will be seen that the opponents of the Sugar Convention have no genuine cause for complaint. The editor of a journal, recently started with the object of securing the re-establishment of the bounty system, continues, however, to spend much of his time in writing to newspapers all over the country, and endeavouring, as he so ingenuously puts it, 'to focus in our column the efforts of agitators' in this direction. He twits the West Indies, and says that they are gaining no advantage from the Convention; but on this point we may perhaps be excused for considering ourselves to be in a better position to speak than he is, and there is no getting over the fact that as a result of the abolition of bounties, two new central sugar factories have already been erected in the British West Indies, schemes for the establishment of two more immediately are assuming definite shape, while only yesterday we heard that the erection of a factory in Barbados was contemplated.

Machinery is going out in greater quantities than for many years past, and there is in every direction abundant evidence that the West Indies are taking heart. Confidence is slowly returning to the sugar market, and when we get a more liberal supply of sugar there must certainly be an improved demand."

Cuba and the Brussels Convention.

The *Deutsche Zuckerindustrie* on learning the particulars of the proceedings which took place at the meeting of the Brussels Convention Committee last spring, gave vent to some criticism of the attitude taken by the Committee in regard to the United States and Cuba. The British delegates are accused of having used every means to prevent disciplinary measures being enacted against American and Cuban sugar. But this was hardly the case. What the British representatives did was to advise a policy of caution, as they considered the Conference was in danger of making pronouncements on purely theoretic grounds, and thereby acting with uncalled-for severity to a dozen or more countries, amongst which the United States and Cuba were to be found. As regards the last-mentioned countries, it was shown that neither of them at present exported any appreciable quantity of sugar to Europe, and until their somewhat complex fiscal systems were thoroughly understood, it would be premature to penalize them. We think this course of action has in part proved justified, for Cuba having been given a warning has hastened to place her sugar régime within the limits allowed by the Brussels Convention. As for the United States, they will themselves want all the sugar they can get for some years to come, and there is therefore plenty of time for deciding whether their sugar shall be penalized or not.

The Colonial Sugar Refining Co.

The Colonial Sugar Refining Co., of Sydney, which controls practically all the refining interests of Australia, has recently found it necessary to construct new and enlarged head offices to cope with its ever-increasing business. A large and handsome five-storey building has been erected in O'Connell Street, Sydney. Here will be located, in addition to the administrative department, the large laboratory and engineering staff which the Company require to carry on their extensive business. This Company employ in busy times from 12,000 to 16,000 people in their various refineries in Australia, New Zealand, and Fiji; their engineers' shop in Sydney; their thirteen sugar mills; and their 30,000 acres of sugar country.

BOUNTIES AND SPECULATION.

The position of sugar during the last quarter of a century,—and especially during the last two years—furnishes some useful lessons in economics which should be carefully studied and recorded while the details are still fresh and striking. The effect of the bounties was twofold; first, in stimulating the production of European beetroot sugar to an abnormal extent, so that the world at last depended, for nearly two-thirds of its visible consumption, on the success of the beetroot crop; and, secondly, by creating a succession of periods of plethora and scarcity which gave rise, at intervals, to great bursts of speculative excitement. In the meantime the rest of the sugar-producing districts of the world were kept in a state of constant apprehension, with periodical spells of bad times. Instead of expanding and progressing with the natural increase in the demand for sugar as time went on, they practically stood still. That they succeeded in surviving the frequent depressions of the market, even below the cost of production, is a striking proof of their wonderful vitality, and of their power to successfully to overcome the artificially stimulated beetroot industry so soon as a fair field for competition is restored to them. As for the consumer, he was sometimes for a brief period enjoying the doubtful advantage of being supplied with an article below cost price, but always paid the penalty when he discovered that glut must necessarily be followed by scarcity, and the unnatural cheapness by an abnormal rise in price.

All these artificial conditions of the world's sugar market periodically gave to the speculator his happy opportunity of fishing in troubled waters. Each great swing of the pendulum between over-production and its inevitable counterpart was accompanied by wild scenes of excitement in all the great centres of the trade. The experience of the last two years is a good illustration of what has gone on at intervals ever since the great fall in 1884. It should be carefully studied as a valuable object lesson.

It was in 1902 that the bounties reached their zenith. The results were a production of 6,900,000 tons of bounty-fed sugar against 3,500,000 tons of cane sugar, and a price of 6s. per cwt. for raw sugar against a cost of production of 9s. 6d. for beetroot and 8s. 6d. for cane sugar. In spite of the Sugar Convention the prices remained below the cost of production until the summer of 1904. There had been a slight reduction in the production of beetroot sugar, but not sufficient to restore prices to their normal level. But then came the great drought of that year which reduced the European crop by about a million tons. Here was a chance for the speculators and they made the most of it. Prices were driven up from 8s. per cwt. in the spring of 1904 to over 16s. in January, 1905. This was the first effect of being dependent (owing to the bounties) on beetroot sugar for our

supplies,—and for the price of them. The second effect was an immediate large increase in the beetroot sowings for 1905-6, stimulated by the high price of sugar. The third effect was a great decrease in visible consumption and consequent increase in visible stocks. The fourth effect was the complete collapse of the speculation and a fall to the old price of 8s. 6d.—again below the cost of production. All these four acts in the drama were the outcome of an abnormal state of things brought about by bounty-fed over-production of beetroot sugar.

The rôle played by the speculator in this drama—which turned out to be a tragedy—is a matter which calls for some examination in view of future dangers. The machinery which enables speculators to deal in imaginary sugar or other commodities for future delivery has often given rise to adverse comment and sometimes to violent condemnation from those who have no practical acquaintance with the subject. As a matter of fact, such a machinery is absolutely necessary, quite apart from speculation, now that commerce and industry have grown into a cosmopolitan affair. A large dealer in produce goes all over the world in the course of his transactions. He must always be in a position to sell large quantities when buyers appear, and yet he must never be a "bull" or a "bear" against his will. It is, therefore, absolutely necessary for the conduct of his vast transactions that he should be able to "cover" sales or purchases so as to keep his account balanced. The machinery for the sale and purchase of "forward" deliveries was created for this purpose, and is not only useful but absolutely necessary. The one thing needful is that it should be organised so as to make every transaction automatically "as safe as the Bank." At frequent intervals "margins" must be paid up and adjusted. In London that is done, and there are no tragedies. Our Continental neighbours must imitate us. When that is accomplished we shall have no more of these wild rises and sudden collapses, because the payment of "differences" very soon sobers the excited operator and leads him to see dangers ahead to which he would otherwise obstinately shut his eyes. Recent events have given us a severe lesson and one which we trust will not be easily forgotten. The lesson having been learnt, the remedy no doubt will be applied.

The Natal Government are prepared to entertain applications for sugar farms in Zululand. Leases will be for a period of 99 years, but no rent will be charged for the first two years. Only one farm will be allotted to each applicant.

Lands are of three classes: First Class, Sugar Land; Rent 2s. per acre per annum. Second Class, land for sugar and mixed farming; Rent 1s. Third Class, land for mixed farming; Rent 6d.

SIMPLE METHODS OF CHEMICAL CONTROL.

By T. H. P. Heriot, F.C.S.

(Continued from page 467.)

V.

The Density Test.

By density, or specific gravity, is meant the weight of anything as compared with that of an equal volume of something else selected as a standard, and, in order that the densities of different substances may also be compared one with another, it is essential that they should refer to one and the same standard. Distilled water being particularly suitable for this purpose, has therefore been universally adopted.

Density may therefore be more exactly defined as the ratio which the weight of a given volume of a solid or liquid bears to the weight of the same volume of distilled water taken as unity, the compared volumes being measured at a definite temperature. The latter qualification is an essential one because, at different temperatures, the same weight of any substance occupies different volumes; or conversely, equal volumes of the same substance vary in weight.

A knowledge of the specific gravities of liquids finds frequent application in the arts and industries, either for calculating weights from volumes and *vice versa*, or for measuring the strengths of liquids as regards the quantity of solid matters held in solution, or the extent of dilution of one liquid by another. Whereas, in the first case, specific gravity serves merely as a measure of relative weight, in the second case *the cause* of the variations in relative weight serves as an approximate measure of composition.

As an example of the former, we find that a certain volume of cane juice weighs seven-hundredths more than the same volume of distilled water, both liquids being measured at 62° F. The ratio of the weights of these equal volumes being, then, 107 : 100, the specific gravity of the juice becomes 1·07 when the weight of water is taken as unity. And since a gallon of distilled water, at 62° F., weighs exactly 10 lbs., we learn that a gallon of such juice must weigh 10·7 lbs.

On the other hand, we find by actual experiment that solutions containing various known percentages of pure sugar differ considerably in density; and, referring to the tabulated results of such experiments,

that a solution of specific gravity 1·070 should contain 17% by weight of pure sugar. But the specific gravities of impure solutions, such as cane juice, being due to the relative specific gravities of each of its constituents, serves only as an approximate indication of saccharine richness.

Of the various methods of finding the density of a liquid, the hydrometer test is by far the simplest, and therefore deserves our exclusive attention. Although some form of this little instrument is to be found in every sugar factory, few of those who use it daily have taken the trouble to learn the principle on which it acts, and the conditions under which its indications can be relied upon.

As in the case of all floating bodies, the hydrometer displaces a volume of liquid equal to its own weight, but, unlike the displacement of a ship, which varies with the weight of cargo, the displacement of the hydrometer varies only with the density of the liquid in which it floats. To render the instrument sensitive to slight differences of density, the upper part, or stem, is given the form of a narrow tube, the total displacement of which is small as compared with that of the submerged bulk of the instrument. The variable displacement of the hydrometer is thus due to the length of stem submerged; which length increases (for equal variations in density) in proportion to the narrowness of the stem. The weight of the hydrometer being constant, it is obvious that the volume of liquid displaced by its submerged portion varies inversely as the density of the liquid, but is always equal in weight to the hydrometer. The principle involved is, therefore, that of comparing the volumes of equal weights of the liquor tested and of water or some other liquid adopted as a standard. If this principle is once clearly understood the reader will be saved much perplexity arising from the various methods of graduating the hydrometer scale, which we must now briefly refer to.

From the sugar maker's point of view, the hydrometer should indicate either—(*a*) true specific gravities (relative weights) from which data the weights of juice and syrup can be calculated from their volumes. Or (*b*) the percentage of dissolved solid matter which is the cause of variations in specific gravity. These two methods of graduating the hydrometer are equally rational and practical. The confusion referred to above is largely, if not entirely, due to a third method of graduation adopted in the Beaumé hydrometer, the degrees of which are arbitrary numbers yielding no intelligible information until reference is made to a table of figures. Not only is this scale graduated on an irrational basis, but, being generally designed to indicate a large range of densities, it also lacks sensitiveness, owing to the relatively large diameter of the stem. When employed in the sugar factory, all the possible densities of cane juice fall within about an eighth part of the scale, on which a quarter of

one degree occupies not more than a twentieth part of an inch. Strange to relate, this most unpractical hydrometer is still preferred by practical men for reasons best known to themselves. As a "workman's test" it may have its uses, but as a laboratory instrument it can happily be dispensed with.

Of the two rational methods of graduating the saccharometer, or 'sugar-hydrometer,' a scale indicating percentages of dissolved solids will be found more useful than one indicating specific gravities, and as both graduations cannot very well be combined on a single scale, the corresponding specific gravities are usually found by reference to a table.

The Brix or Balling scale is graduated to indicate percentages of sucrose when floated in solutions of pure sugar. Such solutions, therefore, take the place of distilled water as the standard adopted. As impurities exert their influence on the density of any liquid, the degrees Brix of cane and beet juices are taken to represent the percentage of sugar plus impurities; in other words, the percentage of total solids in solution. This percentage, deducted from 100, represents the percentage of water. Leaving the exact estimation of the sugar to be made hereafter by the optical test, the Brix scale enables us to arrive at the quantity of sugar per 100 parts of dissolved solids, otherwise known as the "quotient of purity."

It should be noted, however, that since the specific gravity of sucrose is higher than that of the impurities which accompany it, the degrees Brix only indicate *apparent solids*, and these are in excess of the *true solids* (determined by the more round-about method of evaporating a weighed quantity of juice and drying the residue to constant weight). We here meet with an instance where great accuracy is not essential so long as the information yielded is strictly comparative. Whereas measurements of the *quantity* of sucrose in the juice call for every possible precaution in order to check the yields obtained in the factory, the *purity* of the juice, based on the apparent solids, is only a rough guide as to what that yield should be. Even if the nature of the impurities and their percentages were also known, the problems involved in the factory losses would not be solved. Provided, then, that slight differences in the purity of juices can be detected, it is not of serious consequence whether the results are expressed in absolute or relative terms.

Having selected the Brix scale as the most suitable, there still remains the question—at what temperature shall the scale be graduated and used? Most hydrometers, including the Brix, are graduated at European temperatures and require a heavy correction when employed in the tropics, for reasons already stated. Now such corrections may be perfectly reliable and, in some cases, highly

convenient, but unfortunately they do not tend to simplify matters. We therefore prefer a Brix instrument graduated at a mean tropical temperature of 84° F.* and specially made to order. In Chapter II. we have given the approximate dimensions and range of scale which such an instrument should have.

The mere substitution of one kind of saccharometer for another would be of doubtful advantage unless accompanied by greater exactness and attention to details in testing; hence the necessity of a few hints on:—

Making the Test.—In order that the temperature of the sample and of the saccharometer may be as near to 84° F. as possible, the test should be made within the limits of 82°—86° F. If this cannot be arranged (by selecting a suitable hour of the day when the laboratory temperature falls within these limits) the readings of the scale must be increased by one-tenth for every 3 degrees above 84° F., or decreased to the same extent for every 3 degrees below 84° F., as here shown:—

Degrees F.		Reading.		Correction.		Corrected Brix.
78	....	18·2	....	—·2	....	=18·0
81	....	18·1	....	—·1	....	=18·0
82-86	....	18·0	....	Nil	...	=18·0
87	....	17·9	....	+·1	.. .	=18·0
90	....	17·8	....	+·2	....	=18·0

When not in use, the saccharometer is conveniently kept in a cylinder filled with water to such a level that only the uppermost inch of the stem remains uncovered. This end serves for holding the instrument, which should be handled as little as possible.

Having completely filled another cylinder with the juice to be tested, and removed every trace of air bubbles (by blowing off a small quantity of the surface juice), the saccharometer is raised from the water-cylinder, the *stem only* wiped dry with a clean cloth, and the instrument lowered into the juice until part of the stem is immersed, being held centrally in the cylinder. On now releasing the stem, the saccharometer sinks only a short distance before finding its proper level, leaving the exposed part of the stem *dry*. This is important because a *wet stem* increases the active weight of the saccharometer and thus falsifies the reading.

We have already referred to the meniscus of liquids when dealing with measure flasks, and the same phenomenon has to be taken into account when reading off the density from the Brix scale. Figure 14 gives a sectional view of the upper part of the cylinder, showing

* The temperature specified in Chap. II. should be 84° F. instead of 85° F.

the meniscus produced where the liquid surface comes in contact with the sides of the cylinder and of the Brix stem. As the latter is graduated with reference to the normal level of the liquid, which we saw (Chapter III.) to be the lowest point of the meniscus, the correct reading is here 17·4 and not 17·2 as measured at the highest point of same.

Although to some the above precautions may appear to be superfluous refinements, they are necessitated by the obvious defects in this simple method of testing densities. Where extreme accuracy is required, as in many scientific investigations, even the most perfect hydrometer would be considered insufficiently accurate.

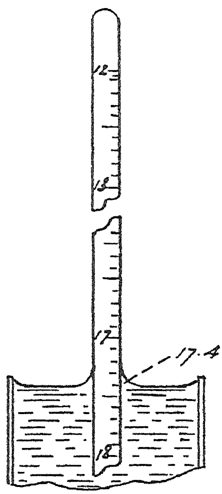

FIG. 14.

In the Table appended to this chapter, the reader will find the weights per gallon of juice corresponding to each degree Brix at 84° F., and we must now explain how these figures were obtained.

Since specific gravity expresses the ratio in weight between a given volume of a liquid and an equal volume of distilled water, at a definite temperature, we have here to apply this principle to the measurements adopted in the factory. The imperial gallon is defined as that volume of distilled water which, when measured at 62° F., weighs exactly 10 pounds. If, therefore, we know the specific gravity (or relative weight) of juice at 84° F. as compared with water at 62° F. we have only to multiply the specific gravity figure by ten in order

to find the weight in pounds of a gallon of juice measured at 84° F.; the reason being that the figure representing specific gravity refers to water as unity, whereas that representing a gallon of juice refers to ten units (pounds) of water.

Tables for converting degrees Brix into specific gravities are published in various text books on sugar, but as such tables are based on the relative weights of juice and distilled water when both liquids are measured at 63·5° F., they are inapplicable at the above mentioned temperature.

The figures in the accompanying Table were therefore determined by actual experiment as follows:—

A Brix saccharometer was ascertained to be accurate by floating it in solutions containing various known percentages of pure sucrose at a temperature of 84° F. After each reading of the scale, a small quantity of each solution was transferred to a bottle (so constructed that it could always be filled to precisely the same level). The bottle plus sugar solution was then weighed, and the tare of the empty bottle deducted. In this manner the weights of equal volumes of sugar solutions at 84° F., varying in density from 12 to 20 Brix, were noted down. The bottle was finally filled with distilled water at 62° F. and the weight of water similarly noted.

The latter weight being then adopted as unity, the specific gravities of the sugar solutions were found by dividing their weights by that of the same volume of distilled water. These values, multiplied by ten, gave the weights (in pounds) of one gallon of each solution corresponding in density to the different numbers on the Brix scale.

The same result is reached more directly if we regard the weighing bottle as a miniature gallon measure. Then, the weight of distilled water at 62° F., which exactly filled it would represent ten pounds, and the weights of the sugar solutions at 84° F. proportionally more than ten pounds.

The results thus obtained were finally corrected for slight experimental errors until they showed graduated differences in the weighings corresponding to the whole numbers on the Brix scale. The intermediate weights, corresponding to tenths of degrees Brix, could then be filled in by calculation. These weights per gallon appear in the second column of the Table and, if the decimal points be (mentally) moved one place to the left, the corresponding specific gravities are seen at a glance.

A second method of expressing the weight of juice is given in the third column of the Table, namely the number of gallons of juice which would collectively weigh one ton. The use of these factors will be more fully explained in a subsequent chapter.

TABLE I.

(To be cut out and mounted on cardboard.)

Brix. at 84° F.	Weight of Juice.		Brix. at 84° F.	Weight of Juice.		Brix. at 84° F.	Weight of Juice.	
	Pounds per gallon.	Gallons per ton.		Pounds per gallon.	Gallons per ton.		Pounds per gallon.	Gallons per ton.
12·0	10·446	214·4	15·0	10·575	211·8	18·0	10·707	209·2
12·1	10·450	214·3	15·1	10·579	211·7	18·1	10·711	209·2
12·2	10·454	214·3	15·2	10·583	211·7	18·2	10·715	209·1
12·3	10·459	214·2	15·3	10·588	211·6	18·3	10·720	209·0
12·4	10·463	214·1	15·4	10·592	211·5	18·4	10·724	208·9
12·5	10·467	214·0	15·5	10·596	211·4	18·5	10·728	208·8
12·6	10·472	213·9	15·6	10·601	211·3	18·6	10·733	208·7
12·7	10·476	213·8	15·7	10·605	211·2	18·7	10·737	208·6
12·8	10·480	213·7	15·8	10·609	211·1	18·8	10·742	208·5
12·9	10·485	213·6	15·9	10·614	211·0	18·9	10·746	208·5
13·0	10·489	213·5	16·0	10·619	210·9	19·0	10·751	208·4
13·1	10·493	213·5	16·1	10·623	210·9	19·1	10·755	208·3
13·2	10·497	213·4	16·2	10·628	210·8	19·2	10·759	208·2
13·3	10·502	213·3	16·3	10·632	210·7	19·3	10·764	208·1
13·4	10·506	213·2	16·4	10·636	210·6	19·4	10·768	208·0
13·5	10·510	213·1	16·5	10·641	210·5	19·5	10·772	207·9
13·6	10·515	213·0	16·6	10·645	210·4	19·6	10·777	207·9
13·7	10·519	212·9	16·7	10·649	210·4	19·7	10·782	207·8
13·8	10·523	212·9	16·8	10·654	210·3	19·8	10·786	207·7
13·9	10·528	212·8	16·9	10·658	210·2	19·9	10·791	207·6
14·0	10·532	212·7	17·0	10·663	210·1	20·0	10·795	207·5
14·1	10·536	212·6	17·1	10·667	210·0	20·1	10·799	207·4
14·2	10·540	212·5	17·2	10·672	209·9	20·2	10·804	207·3
14·3	10·545	212·4	17·3	10·676	209·8	20·3	10·808	207·3
14·4	10·549	212·3	17·4	10·680	209·7	20·4	10·813	207·2
14·5	10·553	212·2	17·5	10·685	209·6	20·5	10·817	207·1
14·6	10·558	212·1	17·6	10·689	209·6	20·6	10·822	207·0
14·7	10·562	212·0	17·7	10·693	209·5	20·7	10·826	206·9
14·8	10·566	212·0	17·8	10·698	209·4	20·8	10·831	206·8
14·9	10·571	211·9	17·9	10·702	209·3	20·9	10·835	206·8

(To be continued.)

THE STOCKS OF SUGAR ON SEPTEMBER 1st.

M. F. Sachs in a recent issue of the *Sucrerie Belge* goes into the question of the stocks of sugar available on September 1st.

He gives O. Licht's figures (in tons of raw sugar) (Estimate A) as follows:—

	1905.	1904.	1903.	1902.
Germany	73,153	216,846	320,880	381,248
Austria	74,453	126,549	74,018	188,187
France*	352,799	510,098	658,229	351,749
Belgium	30,330	75,942	104,370	93,225
Holland	9,816	10,048	33,631	72,504
United Kingdom..	73,485	98,265	138,724	165,775
Russia	220,000	444,387	239,881	89,451
Italy	15,000	40,000	19,200	15,000
Spain..	20,000	32,159	18,552	14,805
Sweden and Norway	6,000	6,000	5,000	27,000
Denmark	5,000	5,000	2,250	3,420
Switzerland	5,000	5,420	6,659	7,933
Roumania..	6,000	8,387	2,017	6,350
Other European Countries	5,000	5,420	6,659	7,933
Hamburg..	105,245	49,795	203,460	207,920
In transit	208,260	147,640	85,244	233,720
North America	210,000	167,409	260,411	180,742
Cuba	245,000	47,558	203,683	199,536
Total stocks . ..	1,659,581	1,991,503	2,377,209	2,238,574

whence we have a deficit of 331,922 tons of sugar as compared with last year.

These figures, it must be pointed out, include the stocks of Russia and some other countries which have not previously been included in these annual calculations.

Herr O. Licht also publishes a table in another form (B), which is as below:—

Stocks on September 1st.	1905.		1904.		1903.
Germany	73,153	..	216,846	..	320,880
Austria	74,453	..	126,549	..	74,018
France*	352,799	..	510,098	..	658,229
Belgium	30,330	..	75,942	..	104,370
Holland	9,816	..	10,048	..	33,631
United Kingdom	150,025	..	188,976	..	176,175
Hamburg	105,245	..	49,795	..	203,460
North America	185,292	..	126,960	..	243,998
Cuba	245,000	..	47,558	..	203,683
In transit	208,260	..	162,260	..	85,244
	1,434,413		1,515,032		2,204,688

* Estimation on September 22nd, 1905.

or a decrease of 80,619 tons of sugar alone as compared with the previous year.

It is noticeable that the figures of 1904 and 1903 do not altogether coincide with those which Herr Licht advanced last year. The same variations appeared last year regarding previous years. It is a pity Licht makes so many modifications not only for the year just past, which is excusable, but also for preceding years, the figures of which ought to have been established long ago.

The confusion grows apace when we investigate the estimates of stocks by other statisticians, *e.g.*, by F. O. Licht. Here are his figures compared with Otto Licht's, in thousands of metric tons:—

	1905.		1904.		Difference.
O. Licht (Evaluation A)..	1,660	..	1,992	..	332
,, (,, B)..	1,434	..	1,515	..	81
F. O. Licht	1,475	..	1,939	..	464

It is fortunate that these statisticians are a little more in accord, at least for 1904. Be that as it may, we do not forget that since the beginning of this year we have combatted the widely spread opinion that the visible supplies on September 1st, 1905, would be altogether insignificant.

We gave as a minimum the following figures on three different dates:—

		1905.		1904.		Difference.
Sucrerie Belge,	1st April..	935,499	..	1,430,392	..	494,893
,,	1st May ..	961,613	..	1,430,392	..	468,779
,,	1st June..	921,388	..	1,430,392		509,004

Our evaluation for September 1st, 1905, was vigorously attacked as being much too high. Yet it will be seen that it is considerably below the mark, especially as we had taken for our basis for last year the figures of Otto Licht (Estimate B). We had besides remarked at the time that our estimate should be considered merely as a minimum, as we had not made allowance for the reduction in consumption during the summer.

Since the above was written M. Otto Licht has been good enough to write and explain some of the anomalies revealed above.

The official figures of the stocks on September 1st, 1904, have been modified as below:—

	First Estimate. Tons.		Final Estimate. Tons.
Germany	245,756	..	216,846
Austria	137,924	..	126,549
France..	500,126	..	510,098
North America	126,276	..	126,960
Cuba	45,000	..	47,558
In transit	147,640	..	162,260
England	98,265	..	188,976
Total stocks	1,436,772	.	1,515,032

The modification made in the French figures was the result of an error committed five years ago; it consequently affects all the last campaigns. As regards the United Kingdom, the figures refer not to the stocks of raw, but to the total stocks, though these are based on the apparent stocks of September 1st.

Herr Otto Licht deplores, as we do, these continual changes, which render accurate deduction a matter of difficulty.

F. SACHS.

THE POLARISCOPIC TEST FOR SUGAR.

When the polariscopic scale came into force with the new Sugar Duties, we pointed out that it would inevitably cause a deterioration in the quality of the sugar made in the West Indies, and thus hinder those improvements which were essential if the islands were to progress. It is to be recollected that grocery crystals are bought by their appearance and not by their polariscopic strength. The weaker the sugar is the less duty it pays, and as the buyer pays no attention whatever to the polariscopic scale, a reduction in the duty is an unmixed gain to the producer. Sugar in crystals of a low strength is, in practice, necessarily of a darker colour, and this strongly militates against the progressive improvement which is essential if Colonial manufacture is ever to compete on equal terms with the best modern sugar—white German granulated. Instead of studying how to adopt every possible improvement, our planters' attention is diverted to the study of how far it is desirable to spoil their sugar in order to evade our revenue. Considerable progress, or rather retrogression in this direction, is already apparent, to the benefit no doubt of London made yellow crystals, which are of a brighter colour. The manufacture of white sugar in the Colonies is also practically prohibited by its being subjected to the highest duty. The polariscopic scale is unequal and unfair, because the proportionate duty on the better sugars is higher than on common ones. There was, however, originally an excuse for the scale until the system of refining in bond was inaugurated. Now that that is the law, the refiner under it pays no duty on his manufacturing loss. There is no reason now for the costly polariscopic test. It adds to the cost of collection while it progressively reduces the gross revenue, and at the same time hinders progress in the West Indies. In fact, the scale is a senseless anachronism.—*(Produce Markets Review.)*

The out-turn of the seven Denmark sugar factories was 88½ million lbs. in 1904, as against 91¾ millions in 1903.

DATES OF THE WORLD'S SUGAR CROPS.

The *Revista Azucarera* gives the following list of the dates of the sugar campaigns in various countries of the world:—

Argentina	June to October.
Australia	June to November.
Brazil	October to February.
Cuba	December to June.
Demerara	October to March.
Egypt	January to April.
British East Indies	December to April.
Guadaloupe	January to June.
Hawaii	December to April.
Jamaica	December to April.
Java	May to November.
Lesser Antilles	January to July.
Louisiana	September to January.
Martinique	January to July.
Mauritius	August to January.
Mexico	December to May.
Peru	October to February.
Philippines	September to March.
Porto Rico	January to June.
Queensland	June to November.
Réunion	September to January.

MICRO-ORGANISMS IN SUGAR JUICES.*

By Albert Schoene.

In connection with a paper he published four years ago, dealing with the same subject, the writer now gives the results of his studies of the pure cultures of the micro-organisms he found in the juices. These results are materially as follows: The writer divides those micro-organisms, which occur in normal juices, into the following four groups:—

1. Leuconostoc and the slime-forming bacilli.
2. Bacteria of the type of Bacillus coli.
3. Bacteria resembling Bac. mesentericus and Bac. subtilis.
4. Indifferent organisms and those whose presence in the juices is purely incidental.

* Archief voor de Java-suikerindustrie.

Group 1.

To this group belongs, in the first place, the well-known and much dreaded Leuconostoc mesenteroides, which the author found in the juices of the four factories in which he conducted his investigations. He particularly draws attention to this fact, as other investigators deny the existence of this bacterium in normal juices.

Owing to the peculiar habits and the diversity in the form of growth of this microbe, variations depending upon the composition of the nutrient medium, the temperature, &c., it may easily be overlooked; the characteristic jelly is formed only under certain conditions, otherwise it is difficult to distinguish this microbe from a simple coccus.

The Leuconostic isolated and grown by the author is beyond doubt the same as that described by Liesenburg and Zopf. Besides this one, Schoene found two other cocci, both of which form slimy bodies. He named them coccus I and coccus II. The former produces, besides slime, a gas (not studied), acetic acid, little lactic acid, succinic acid and sulphuretted hydrogen; but no jelly-like mass, such as is formed by the Leuconostoc.

The latter, very similar to coccus I, differs from it inasmuch as coccus II has the power of coagulating milk; its products are a gas, acetic acid, and dextro-rotary lactic acid.

To this same group belongs a short baccillus, which also has the property of forming slime in profusion; this bacillus at times assumes the form of a coccus. It is found on fresh chips and in the diffusion juice. Besides that slime, which gives with water an opaque solution, out of which it is precipitated by alcohol, the products of this organism consist of gas, a little alcohol, acetic acid and laevo-rotary lactic acid.

Group 2.

Together with the above named organisms the diffusion juice contains bacilli, which belong to the group of the coli bacteria, or at least closely related. They are also found in the syrup and the massecuite. Description: Short, thick bacilli in constant rapid motion, thickness ·8 to 1·2 microm., length, 1·5 to 3·0 microm. Four of the different kinds of bacteria belonging to this class (named A. B. C. and D. by the author) were made the subject of a special study. The temperature-optimum of all the four is high, about 50° C., as also is their power to attack sucrose, forming gases (mainly hydrogen, in the case of bacterium C. 10% carbonic acid and 90% of a combustible gas) and acids without previous inversion.

Bacterium A also acts on dextrose, levulose, maltose, lactose, mannite and probably starch, forming mainly succinic acid and laevo-rotary lactic acid, further considerable quantities of alcohol; on media containing albumin also sulphuretted hydrogen and Indol.

Bacterium B forms less gas than A and no succinic acid; but alcohol, acetic acid and laevo-rotary lactic acid; on media containing albumin sulphuretted hydrogen is given off.

Bacterium C is very similar to the two previously described ones. The colonies remind one of colonies of the typhoid bacillus. It's products are alcohol, acetic acid, laevo-rotary lactic acid, a great deal of succinic acid and gas, accompanied by a perceptible formation of slime.

Bacterium D differs from the three above by its lack of motion. It appears to be related to Bacterium aerogenes, which is by some authorities considered as a cilia-less form of bac. coli. Sugar solutions are made viscous by this organism. Alcohol precipitates from such a solution a gummy substance, which, redissolved in water—the solution is opaque—reduces Fehling's solution only when heated with hydrochloric acid. The faculty to form carbohydrates (this substance consists of carbohydrates) has hitherto not been ascribed to this group of bacteria.

Sucrose, Dextrose, Levulose, Maltose, Lactose, Mannite and probably also starch are decomposed, while gas is given off. Carbohydrates are transformed by this micro-organism into slime, gas, alcohol (considerable quantities), acetic acid, valerianic acid (little), dextrorotary lactic acid and succinic acid. For every 20 parts of acetic acid there is about 1 part of valerianic acid. An analysis of the gas showed 43·5% carbonic acid and 65·5% hydrogen. Sulphuretted hydrogen and tudol are formed in presence of albumin.

Group 3.

This group embraces all the motile bacilli propagated by spores, which are to be found in all juices.

As the author stated in his previous communication, he found several organisms belonging to or related to this group.

Clostridium gelatinosum differs from the other members of this group inasmuch as it forms on top of the sugar solution a thick, jelly-like, wrinkled skin. This skin consists of carbohydrates, which, on boiling with diluted sulphuric acid, yield fructose. The products of the activity of the organism are alcohol, acetic and lactic acid. But little gas is given off. Laxa found carbonic acid. The organism inverts sucrose. Sulphuretted hydrogen and ammonia are formed in presence of albumin.

The organisms belonging to the mesentericus group are long, motile bacilli. As to their behaviour towards sucrose and liquids containing sucrose but little is known.

Bacillus mesentricus fuscus, occasionally found by Schoene, forms, when grown on sugar-gelatine-plates, lighter coloured colonies, resembling small drops. Sugar solutions become very viscous and opaque. Its products are alcohol, acetic and a little valerianic acid, sulphuretted hydrogen and tudol. The sucrose is inverted.

Bacteria belonging to the hay-bacillus group were also found, particularly bacillus subtilis. This latter inverts sucrose, forms a little acid, and a slime, which, precipitated with alcohol, gives with water an opaque solution ; another product of bacillus subtilis is a diastatic, peptonizing ferment.

GROUP 4.

Besides the above described saccharolytic bacteria, a number of others, either indifferent towards sugar, or the presence of which in the juices must be considered as merely incidental, were isolated. Their description does not come within the scope of this paper.

The next point to be considered is, under what conditions do these micro-organisms become harmful to sugar solutions ? In the first place they are capable of transforming sugar into jellies and slimes. The faculty of using the sugar to build up the cell-membrane and of turning it into a slimy or jelly-like carbohydrate, is very frequently met with. The sugar thus used up is, of course, lost to the juice, and, as it has disappeared as sugar, it escapes the control.

These bacteria have further the faculty to form acids from the carbohydrates; some invert the sucrose and cause a formation of alcohol and gas.

The often heard statement, that bacteria cannot live in an acid liquid such as diffusion juice and at a temperature of from 40° to 70° C., is completely refuted by the observations and experiments made by the author. Leuconostoc can withstand a temperature of 75° C. for 15 minutes, or, if 43 minutes be taken for the heating, even 86 to 87° C. for five minutes. The bacteria of the bacillus coli type can likewise endure high temperatures. Clostridium gelatinosum, as also the bacteria of the mesentericus and subtilis groups manifest increased vital power at temperatures above the ordinary.

Observations recently made, show conclusively that the addition of disinfectants to juices for the purpose of preservation, does not have the desired effect. The explanation of this lies probably in the fact, that disinfectants, such as phenol, formalin, &c., while they kill the microbes, do not stop the activity of the enzymes formed by them.

(E. E. H. in the *Planters' Monthly*.)

On October 5th, the Norwegian Storthing agreed by 89 votes to 28, to raise the duty on sugar from 20 to 30 ore per kilo. (£11 to £16 10s. per metric ton.)

The Association of Java Sugar Manufacturers have just estimated the production of raw sugar in 1905, at 1,046,000 metric tons, as compared with 1,083,000 tons in 1904. The area under cultivation for 1906, is stated to be 108,000 acres.

THE POLARIMETRIC DETERMINATION OF SUCROSE.

It will be remembered that in our September issue we published a contribution from the pen of Dr. Wiechmann, in discussion of the paper, "The Polarimetric Determination of Sucrose," by the Hon. Francis Watts, C.M.G. and Mr. H. A. Tempany, which originally appeared in the *West Indian Bulletin*, and was reproduced in our August number. Messrs. H. & L. Pellet have reproduced this paper of Watts and Tempany, as well as a summary of Dr. Wiechmann's remarks in the September number of the *Bulletin des Chimistes*, and thereupon offer some criticisms on them.

Dealing first with the influence of temperature on the optical activity of sucrose, these French writers say:—

"First, as regards the preparation of pure sucrose, it appears to us to be very difficult, if not impossible, to obtain it absolutely free from ash and organic impurities. Admitting that the sugar was weighed in a perfectly dry condition, we would have preferred experimental evidence that the sugar contained no appreciable quantity of mineral matter.

"Such sugar can be prepared by our process of slow crystallization from an alcoholic solution instead of by precipitation. But this offers no advantages over the use of the best refined sugar in which the percentages of water and ash have been determined, and the organic matters calculated by means of the ordinary coefficient. Deducting these impurities from 100, the difference gives the amount of pure sucrose with more accuracy than any direct preparation.

"These gentlemen admit that the polariscope read exactly 100 by the Wentzke scale, having been certified as accurate, first at Charlottenburg and then by Dr. Wiley at Washington. We have no reason to doubt the accuracy of Dr. Wiley and of the experts at Charlottenburg in verifying the Schmidt and Haensch instruments, but we cannot refrain from remarking that all operators do not always read the same; the 'personal error' being sometimes as much as + 0·1 or — 0·1. The differences between the extreme points are the same, but not the observed readings.

"We should have liked to have found some evidence in Messrs. Watts & Tempany's report that they also obtained readings of 100 when working with sugar solutions, at 17·5 C., prepared by dissolving 26·048 grams in 100 cc. Mohr., and employing a verified flask; in short, that the test had been made as we should have made it—namely, by preparing a solution at 15-16° C., which polarizes approximately 100. Then preparing another solution containing the same weight of sugar per 100 cc. but prepared at 25° or 30° C. and polarized at this temperature; the difference between the two readings being then noted.

"For this kind of test we prefer not to take quantities of sugar giving exact readings. Working thus, we obtained different results to Messrs Watts & Tempany; our mean correction for temperature being 0·00012 instead of 0·00023.

"On the other hand we have said that our results could not be absolutely accepted in every case, but that each experimenter should be guided by experience. The only point we had in view was to see if temperature exerts any practical influence on the optical activity of sucrose. This being the case, it only remains to discover the extent of this influence by several experiments. In fact a very small error in these experiments produces an appreciable difference and we, also, have obtained values higher than 0·00012.

"We therefore desire that new tests be carried out, employing very sensitive saccharimeters capable of giving duplicate readings with the same sugar solution to within $\frac{1}{20}$ of a degree of the scale. We ourselves propose to make the attempt with instruments of recent manufacture, using every possible care; and hope ere long to publish the results.

"All that can be said at present is that the rotatory power of sugar is slightly diminished by a rise in temperature; and that it is not immaterial whether liquids be polarized sometimes at 7° or 8° C., at other times at 25°-27° C. or even 30° C., as is now and then done in certain countries. It may be added that a note by Dr. Wiechmann appeared in the September *International Sugar Journal*, in which he likewise expressed his doubts regarding the purity of the sugar prepared by Kahlbaum and used by Messrs. Watts & Tempany."

Regarding "The Influence of Lead Precipitate on the Polarization of Sugar," Messrs. Pellet make the following comments:—

"Messrs. Watts and Tempany have good reason for stating that the methods of Scheibler, Sachs and Wiechmann are not accurate for the determination of the influence of the lead precipitate. We, however, fail to see that the methods which the two authors have themselves adopted are any more accurate, as they have been used by one of us in the course of similar investigations. For in all these tests it is taken for granted that the precipitate formed in the solution has no action on the sugar and does not carry down any sugar. Now, many experimenters have found, on the contrary, that a loss of sugar actually occurs, and that save in certain cases there was no need to take account of the influence of the lead precipitate. When recently carrying out some new experiments in this connection we found that if we ignored small quantities of the lead precipitate, as in the case of beet juice, we did not need to correct for it when testing products already clarified, such as juices, syrups, masse-cuites, &c.

"M. Vermahren has also dealt with this question and has arrived at the same conclusion as ourselves. In our experiments we adopted

an entirely different method to that of Sachs, Scheibler and others. We prepared a large quantity of the lead precipitate which, after being carefully washed, was decomposed with sulphuretted hydrogen. A known weight of this concentrated liquid was added to a sugar solution to furnish a weight of precipitate which should correspond to that found in the liquid to be tested (raw or carbonated juices, &c.). It was then noticed that the influence of the precipitate on the polarization of the raw juice was appreciable, but less than that indicated by calculating the volume occupied by the lead precipitate, determining its weight and its density. So that for solutions of carbonated juice which give very little precipitate, the latter has no influence on the polarization. This point was also observed by Sachs in the course of his experiments.

"In experiments with beet juices of different purities, quantities of lead precipitate were found which were approximately equal to those obtained from the normal weight of muscovado sugar.

"We therefore think that for raw cane sugar as well as for beet sugar, there is no need to correct the polarization for the possible influence of the lead precipitate.

"As regards Dr. Horne's method, which Messrs. Watts & Tempany consider a great improvement, we would point out that at all events it is not new. It was used years ago for beet juices by M. Pagnoul (see the *Bulletin de la Station agronomique du Pas-de-Calais*, 1885). We think indeed that Pagnoul was the first one to propose the employment of solid sub-acetate of lead for the clarification of sugar products. However, we have tested this substance ourselves and have shown that solid sub-acetate of lead does not exist, at all events in the form in which it is prepared, for this product is only an imperfect and uncertain mixture of the sub-acetate and acetate of lead. It is evident that if the lead sub-acetate be concentrated directly, the homogeneous mixture will act the same way as the liquid sub-acetate; but as this was not done at the time referred to it led to the method being abandoned. Besides, there was never any certainty of obtaining an absolutely dry product. Apart from this, Dr. Horne's method does not appear to be less subject to error than the older methods.

"First, because of the possible presence of moisture; second, because it is difficult to avoid adding an excess of the re-agent. Finally, in a given weight of anhydrous sub-acetate of theoretical composition, only one portion of the lead oxide is active; the other portion dissolves. This latter portion, on passing into solution, increases the volume of the liquid and thus diminishes the polarization. In fact, this led Dr. Horne to say that the volume entering into solution appears to exactly compensate for the complex precipitate produced.

"From our point of view, the results given by Watts & Tempany are not very convincing. We would repeat that the best method of

ascertaining whether the lead precipitate does, or does not influence the polarization of muscovado sugars is to prepare the precipitate from the same kind of sugar, wash it, decompose it with sulphuretted hydrogen, and concentrate the filtrate. Knowing the composition of the latter and the amount of organic matter contained in a given weight of raw sugar, a known volume of this solution is added to a pure sugar solution and, finally, the sub-acetate of lead. The volume is then accurately adjusted, and the liquid mixed and filtered. On polarizing the clarified filtrate, it is then seen whether the result is influenced by the precipitate formed (and which is obviously of the same nature as the precipitate obtained on clarifying a solution of raw sugar). As far as our own experience goes, there is absolutely no effect.

"But there is another important point to consider. Messrs. Watts and Tempany advise the making of a correction for the influence of the lead precipitate, or, better still, to employ solid sub-acetate of lead to the amount of 0·35 gr. for the normal weight of muscovado sugar to be clarified, and to take into account the influence of the temperature on the quartz and on the sugar, by adopting the formula:—Polarization $\pm$ (0·00039t) N, where 0·00023 is for the influence of the temperature on the sugar alone, and 0·00016 for the influence on the quartz.

"This does not appear to us as accurate. In polariscopic work, it frequently happens that either the saccharimeter is at the temperature of 20°-25°-30° C., *i.e.*, at the temperature at which solutions are usually polarized, or else the saccharimeter is at the temperature of 12°-15° and the solution itself is at 20°, 25°, or 30° C. In such a case the correction mentioned above is not generally applicable.

"Again, if a polariscope is to be used in a tropical country at the constant temperature 25°-27° for instance, instead of applying a correction, it appears to us to be simpler to determine experimentally what normal weight should be taken to obtain a reading of 100, the liquid itself being likewise at 25°-27°. If, however, with a polarimeter so adjustable we have occasion to polarize liquids at 28°-30°-32° C. or at 20° C., then the correction need only take into account the influence of the temperature on the sugar.

"If, however, the polariscope is itself subject to constant variations of temperature, it becomes necessary to know the exact temperature of the quartz plate as well as of the liquid, and to apply the several corrections required. In such a case the polariscope ought to be verified by several tests in order to arrive at the true normal weight; these tests being made at a temperature of 15°, 20°, or 25° C. according to the mean temperature of the locality.

"This suggests the desirability of having a special polariscope-room maintained at a constant temperature, by artificial means if necessary,

and where all the liquids to be tested could be brought to the same temperature. But apart from all that, there is another point which has not been indicated either by Dr. Weichmann nor by Messrs. Watts and Tempany. This is the action of the sub-acetate of lead on the reducing substances contained in muscovado sugar, and also the optical activity of these reducing substances when cane sugar is being polarized.

"It seems to us that in all these cases it is overlooked that a considerable quantity of sub-acetate of lead precipitates some of these reducing substances, and thus increases the polarization to the right; and that the reducing substances not precipitated also possess the power of acting on polarized light. The only logical alternative which will avoid disagreement in the analytical results of the same sample of raw sugar, is to determine the polarization by means of Clerget's process, this being the only rational method in our opinion.

"It is certain that several kinds of brown sugar will give the same results by direct polarization as by the Clerget process; but others will certainly not give the same results, particularly muscovados yielding as much as 0·7 or 0·8% of dry lead precipitate per 26 gr. of material. It appears, moreover, that certain sugars give less by the Clerget than by the direct polarization method when a large quantity of lead re-agent is used. Consequently we propose to the International Commission for the verification of sugar analysis that they decide:—

"1. The Clerget method for the analysis of raw cane sugars.

"2. That the influence of lead precipitate be ignored until the new experiments made in the manner suggested above go to confirm our results or those of Messrs. Watts and Tempany.

"3. That the employment of dry sub-acetate of lead for the said analyses should be abandoned.

"4. To allow for the influence of temperature and, until superseded, the conclusions which have been adopted by the International Commission for uniform methods of analysis of sugars, in their sitting of July 24, 1900."

Messrs. Hugh Kelly & Co., 79-85, Wall Street, New York, have under construction at Jatibonico, Cuba, a large new sugar mill for the Cuba Company. The mill house will be 60 feet by 325 feet. Electrical motive power will be largely employed, and the equipment will include two 270 kw., 500 volt, direct current dynamos.

It is said that hundreds of small cane mills are being imported into Jamaica from the United States for the use of the peasantry. These are admitted duty free and cost about £10 10s. each.

THE BRASMOSCOPE AND THE BRIXOMETER IN THE SYSTEMATIC BOILING OF MASSE-CUITES.

By M. G. Leurson.

The boiling of low grade masse-cuites is still generally conducted without any control which might dispense with the uncertain test of boiling to "string-proof." Notwithstanding numerous attempts in this direction and the designing of apparatus as a substitute for empiricism, routine practice has not, up to the present, been dislodged from all its positions by scientific method, and the pan boiler remains master of the situation to the detriment of the regularity of his results.

In spite of the simplicity of the Curin Brasmoscope, many consider it too complicated and scientific an instrument for the pan boiler's use, and sacrifice its valuable indications in order not to disturb the old routine.

Presumably, the necessity of any kind of manipulation, with the possibility of mistakes in handling the movable scale, have led to the exaggerated ideas concerning that instrument.

As is generally known, the Brasmoscope is based on the following principle. The excess of temperature of a boiling syrup (of a given water-content or degrees Brix) over that of water boiling under the same conditions of pressure or of vacuum, is constant, whatever may be the pressure or the vacuum. It is also known that the complete apparatus comprises three parts:—

1. A mercury barometer.

2. A Centigrade thermometer, each degree of which has a length of 5 millimetres and corresponds to a variation of 1 centimetre of the barometer.

3. A movable scale of temperatures of the boiling points of syrup corresponding to the Brix degrees, adopting the same basis of 5 millimetres per degree as for the thermometer.

Having, by means of this combination, determined the final temperature of a masse-cuite at the corresponding vacuum, by suitably moving the scale, one can read off the degrees Brix and thus ascertain the actual water-content of the masse-cuite obtained. Similarly, given a syrup of known composition, one can determine *a priori* at what final temperature the strike should be boiled, under a known vacuum, in order to furnish a masse-cuite of a given water-content.

Although the manipulation of the scale is very simple, we have sought to still further simplify the means of obtaining the same indications, the importance of which cannot be too strongly insisted upon. Since the water-content of a low grade masse-cuite is the primary element affecting the yield and the degree of exhaustion of the mother-liquor produced, we have constructed a Table, which we have named the Brixometer, reference to which gives the indications required for systematic pan boiling.

In the first part of the Table are given the boiling points of water at different vacua. In the second part, the excess of temperature of a boiling syrup, of known Brix, over that of the temperature of water boiling under the same vacuum. Knowing then :—

1. The exact vacuum under which the pan is worked.
2. The temperature corresponding to the boiling point of water.
3. The temperature indicated by a good thermometer plunged in the boiling masse-cuite.

Opposite the number in the second part of the Table, which represents the difference between the above two temperatures, is found the degrees Brix of the syrup at the moment of making the test. One can then follow the progress of the concentration by the increase in the excess of temperature throughout the course of the boiling, and, by the final excess, ascertain the water-content of the discharged masse-cuite. Similarly, given a syrup of known richness and purity, and knowing the conditions under which the masse-cuite is to be discharged from the pan, definite instructions can be given to the pan boiler as to the conditions under which the strike should be boiled and discharged, by fixing for him the vacuum to be maintained and the final temperature which he should obtain with this vacuum, when the completion of the operation and the moment for striking out arrives.

If to the Brixometer there be added a Table of solubilities of sugar, according to the temperature $t°$ of the solution, or simply the following formula as condensed from such a Table :—

$$\text{Sugar dissolved per 100 grams} = 65 + 0{\cdot}25\ t°.$$

Then, knowing the contents of water and of sugar in the masse-cuite, one can determine :—

1. At what temperature the water present will become a supersaturated solution of sugar, and, consequently, at what temperature crystallisation will commence.

2. The quantity of sugar which will be held in solution by the water in the masse-cuite when centrifugalled at 35° to 40° C.

3. And finally, to calculate the possible yield of crystallizable sugar from the masse-cuite, taking into consideration the loss of crystals through the centrifugal liners.

BRIXOMETER.

VACUUM.			MASSE-CUITE.		
Inches.	Centimetres.	Boiling-point of water.	Excess temperature of Masse-cuite over boiling-point of water.	Brix.	Water.
				Per cent.	Per cent.
20	54	68·5	0	0	100
20¼	54·7	67·8	1	34	66
20½	55·5	67·0	2	51	49
20¾	56·1	66·5	3	59	41
21	56·7	65·6	4	63·5	36·5
—	57·3	65·0	5	67·5	32·5
21½	58	64·1	6	70	30
—	58·8	63·4	7	72	28
22	59·5	62·5	8	74	26
—	60·2	61·8	9	75·5	24·5
22½	60·8	60·7	10	76·9	23·1
—	61·4	59·8	11	78·5	21·5
23	62·0	58·7	12	79·8	20·2
—	62·8	57·8	13	81	19
23½	63·5	56·5	14	82·5	17·5
—	64·2	55·5	15	83·9	16·1
24	64·7	54·0	16	85	15
—	65·5	52·8	17	86	14
24½	66·2	51·5	18	87	13
—	66·8	49·8	19	88	12
25	67·5	48·0	20	89	11
—	68·3	46·5	21	89·9	10·1
25½	69·0	44·5	22	90·6	9·4
—	69·6	42·3	23	91·4	8·6
26	70·2	40·0	24	92·3	7·7
—	70·9	37·5	25	93·1	6·9
26½	71·5	35·0	26	93·9	6·1
—	72·4	36·7	27	94·5	5·5
27	73·0	28	28	95·3	4·7
—	73·8	28	29	96	4
27½	74·3	28	30	96·8	3·2
—	75·0	28	31	97·4	2·5
28	75·6	28	32	98	2

Solubility of sugar at temperature t°:—

Sugar dissolved per 100 grams $= 65 + 0{\cdot}25\ t^\circ$.

Moreover, by means of the Brixometer, the true Brix or water-content of any syrup or masse-cuite can be immediately ascertained without analysis, even when the boiling point in vacuo cannot be ascertained. It suffices to heat half a litre of the syrup or masse-cuite in question to the boiling point in a vessel open to the air and immersed in an oil bath, and, from the excess in temperature of the boiling point over 100° C., the above Table will indicate the true degrees Brix and consequently the water content sought.

The Brixometer, with the solubility formula appended, can be constructed of enamelled sheet-iron and permanently fixed to the vacuum pan.—(Translated from the *Bulletin de L'Association des Chimistes*.)

INDIA.

THE SUGAR-CANE CROP, 1905-6.

The first general memorandum on the sugar-cane crop of the season 1905-06 is dated Calcutta, August 17th, and is as follows:—

Of the total sugar-cane crop of British India, the four provinces now reported on together produce $92\frac{1}{3}$ per cent., in the following proportions: United Provinces, 48·1 per cent.; Panjab, 13·6 per cent.; Bengal, 29·6 per cent.; North-West Frontier Province, 1 per cent. These percentages are calculated on the averages of the five years ending 1903-04, and in the same period the average total area of the reported sugar-cane crop of British India was 2,470,000 acres.

All these provinces report a contraction of area in the current year's crop as compared with last year's. The total decrease in these provinces amounts to 190,700 acres, or about $8\frac{1}{2}$ per cent. on the sugar-cane area finally estimated last year, and the net area sown would appear to be about 2,032,000 acres.

In northern India the marked decline is ascribed to the injury wrought on the seed-canes by the abnormal frosts in the beginning of the current year.

The following is a summary of the Provincial Reports:—

United Provinces of Agra and Oudh (48·1 per cent.), while unable till December to state the exact area sown, compute them at some 5 per cent. less than last year, when they stood at about 1,243,000 acres. The contraction is ascribed to the damage done to seed-canes by the frosts in the beginning of the year; and it is estimated that in the Meerut, Agra, Rohilkhand, and Allahabad divisions the crop will fall short of the normal by some 20 per cent. Germination, which is reported to have been somewhat defective in this particular region, is said to have done well in the rest of the province; and in Benares,

Gorakhpur, and Oudh a full normal yield is expected, provided that the remainder of the season proves favourable.

Bengal (29·6 per cent.).—The area actually sown is reported to be 622,300 acres, giving a fall of 1 per cent. below the 628,800 acres of last year. In the Patna division, which grows most of the sugarcane in the province, rainfall was very deficient in June. The Chota Nagpur and the Bardwan divisions also suffered from drought in that month, while some of the districts of the Dacca and Rajshahi divisions suffered from excessive rainfall in July.

Panjab (13·6 per cent.) reports an area of 204,600 acres against 325,500 acres finally returned last year. This represents a decrease of 37 per cent., which is attributed in part to want of rain and mainly to the destruction of seed by the severe frost of last winter. The crop is reported to be in fairly good condition, but has suffered from the attacks of white ants in the district of Gujranwala, and from those of *kiri* in Sialkot.

North-West Frontier Province (1 per cent.) reports an area of 24,800 acres as compared with 25,900 acres finally reported last year, or a decrease of 4·2 per cent., which is due to the standing crops reserved for "setting" having been seriously injured by the severe cold of last winter.—(*Commercial Intelligence.*)

FRANCE.

The Sugar Campaign, 1904-05.

The number of French beet sugar factories in operation during the 1904-05 campaign has been 270, as compared with 292 in 1903-04, being a decrease of 22. In 1883-84, there were 483 factories at work.

The area under beet cultivation is unofficially estimated at 191,160 hectares, as compared with 236,874 hectares during the previous year; this amounts to a decrease of 45,274 hectares, or 19 %. It may be added that in 1901, the area attained, according to official figures, to 312,465 hectares.

The production of sugar, calculated in refined, amounted to 562,736 metric tons (23·6 metric tons to the hectare) as compared with 727,267 metric tons in 1903-04. The percentage yield of sugar per weight of roots was 12·25, as compared with 11·17; and the yield of sugar to the hectare was 2949 kg.

The French consumer has greatly benefitted the past two years, through the reduction in the duties. In 1902-03, 371,119 tons of sugar were consumed. In 1903-04, thanks to the plentiful supply and to the abundant fruit crop, it rose to 699,000 tons. In 1904-05, on the other hand, the markets have not ruled favourably; the higher prices and a less abundant fruit crop, have had their effect in reducing the consumption to 542,314 tons.

THE AUDUBON SUGAR SCHOOL.

By Dr. C. E. Coates, Louisiana State University.

The recent retirement from public life of Dr. W. C. Stubbs has drawn attention again to his many-sided influence on the progress of Louisiana. Of the various enterprises which he inaugurated, not by any means the least important is the Audubon Sugar School of the Louisiana State University. This school is now entering on its fifteenth year and has won for itself a reputation which is literally world wide. Some years ago, it was investigated by one of the most eminent English experts on sugar culture, who recommended it in most flattering terms in a subsequent magazine article. It has also been investigated officially by the Japanese government, with the result that three men were sent to the University—one of whom graduated in 1905. It has drawn students from Hawaii, Japan, France, Germany, Peru, Costa Rica, Mexico, Porto Rico, Cuba, and other foreign countries, while most of the States of the Union are represented on its rolls. In view of these facts and in memory, also, of the saying that "a prophet is not without honour save in his own country," it has been decided to state briefly to the people of Louisiana the main objects of the school and the general record of its graduates.

It is a well-known fact that the best men in cane sugar work come from Louisiana. This is only natural, for the Louisiana planter has always had to make sugar without regard to the favours of nature. In the tropics there are none of the difficulties of making sugar. If a man be taught a good method, he can follow it year after year, by rule of thumb and with fair success. But in Louisiana it is the unexpected which is always happening. Now the cane is too green, now it is sour, now it seems right but the juice refuses to boil to grain. In each case there is a best course to follow, and never twice quite the same course. So the Louisiana sugar man must be prepared to meet any possible emergency. He must plant his cane properly, cultivate it properly, fertilize it and protect it from insect pests, and he must cut it at just the right time. He must understand stock, for this is one of the most important items of expenditure on a sugar plantation, and one where a great deal of money may be saved or lost. In other words, the Louisiana planter must be a thoroughly good farmer.

Then, when the cane is cut, comes the mechanical part. It can be loaded by machinery, brought to the mill by machinery, crushed, ground, the juice evaporated, the sugar crystallized and put in barrels—all by machinery. These machines are costly and some makes are better than others. To get machinery for a small sugar house costs over one hundred thousand dollars. The planter must be

able to choose his machinery, to see that it is put up properly, and, above all, to see that it is run properly. He must, therefore, be a mechanical engineer.

But the process by which sugar is made is more than mechanical, it is also chemical. The more successful the planter, the more strictly does he insist on chemical control of the sugar house. He must, therefore, be a chemist. Now it may be said that no planter can be, at the same time, farmer, mechanic, and chemist. He must employ men to do these things for him. This is very true. He does employ such men, but it may be put down as an axiom that no man is capable of judging truly the work of men under him unless he is able to do that work himself, should the case demand it. This idea is followed in all the great business houses of the North. The son who is to succeed his father is put in at the bottom and worked as rapidly as possible through the various parts of the business. Experience has shown that this line can best be followed by men who have had college training in the technology of the industry in question. For example, the General Electric Company takes the graduate of the "Boston Tech," starts him in the shops at $5 per week, and keeps him in each grade of the work until he knows it. Then he goes on to the next grade and finally becomes an "expert" for the company. Men who have not a college training have almost no chance, indeed it is rare that they can even get a trial. Science has come into technology to stay, and the leaders in industrial enterprises know this. The same thing holds in the sugar industry, which is the most scientific branch of agriculture. It is true that the planters of the past generation and many of the present did not have this college training, but gained their success by common sense and hard knocks. But the conditions of to-day are vastly different from those of the past few years, and it is to meet these new conditions that the Audubon Sugar School exists.

The course of study runs through five years, devoted mainly to three lines of study, viz., Agriculture, Mechanical Engineering, Chemistry. These three subjects and their foundation subjects are taught thoroughly, and the course is not easy. Indeed it is a difficult course, for which reason the University admits as special students men who may fail of the requisite preparation in one or more branches. These men elect, generally, chemistry; sometimes chemistry and agriculture; sometimes chemistry and mechanics. They are allowed to take whatever they are prepared to take. But it is better to take the regular course, for here the studies have been balanced so that each strengthens the other. At the end of the third year the student has studied the elements of chemistry, agriculture, and mechanics. He has been drilled in the fundamental principles of these subjects. He has been taught to regard them not as things he has "taken," but as tools he has acquired with which he is to

work every day. He is now prepared to specialize. This high standard of preparation takes time and work, but it is necessary. All the great technical schools of Germany and of this country follow this plan on the general principle that short cuts either to wealth or to knowledge do not pay in the long run. The fourth and fifth years are the really significant ones for sugar work proper, and are largely of the order of post graduate work.

An important feature of these two years is the practical work at the Sugar Experiment Station at Audubon Park, New Orleans. At this station there is an equipment worth over a hundred thousand dollars, by all odds the most complete equipment for scientific work in cane sugar in existence. In Louisiana the sugar season usually begins about the middle of October and runs for about ten weeks. During this time the students prepare the ground for next year's crop, plant and cultivate the cane, harvest this year's crop, grind it, boil and crystallize the sugar, &c. In short, they carry out practically the entire operation of making sugar from the planting to the finished product, under strict control.

Upon their return to the University, the students take up work in these three main branches which bears directly upon the technology of sugar. They have courses on the detailed agriculture of cane, they draw the various machines found in the sugar houses, they study the chemical properties of the sugar, &c. For scientific work the equipment of the chemical department is particularly noteworthy. The details of these lines of work can be found in the circular published by the University, which will be sent on application to President Boyd.

At the end of five years the student "graduates" with the degree of B.S. He has worked hard for five years. The question now arises—Does it pay? What has he for his work? Is the sugar planter justified in requiring his son to do this work? This is a fair question, for he has no precedents to guide him. Scientific training in cane sugar is a new thing. The answer to these questions is simply this: The course is modelled after the very best courses in other lines of technology; it has met with the approval of every one who has examined it closely; it is carried out by competent men, who make use of the finest collection of instruments and machinery ever gotten together for this purpose. But the most convincing answer to the man who is not somewhat of a student of educational matters is the success which has attended the graduates of the University who have taken up sugar work. These men are now working all over the sugar making world; one manages a beet sugar house in Wisconsin, one supervises a cane sugar plant in Hawaii, another takes absolute control of a sugar estate in Cuba. Maxwell of '94 has charge of a large plantation in Louisiana, and when the season here closes takes charge of a larger one in Cuba. Walsh is considered

one of the ablest sugar men in Porto Rico. Moore of '02 is assistant superintendent at Burnside, whilst Boyd of '02 is assistant superintendent at Shadyside. Houck, Kennedy, Le Blanc and Rincon are making enviable reputations; and going down the list of students it is impossible to find a single man who has not proved himself a success.

Every year the University is compelled to turn off applications for sugar men. The demand far exceeds the supply. As to the salaries, that is something which depends upon the individual to such an extent that it is hard to discuss it fairly. When the men start out they get from $75 to $125 per month. At the end of four years' work, two men the writer has in mind are making about three thousand dollars per year. One other of longer experience makes five, still another makes ten thousand. These are the successful cases of course; but they serve to show that the right man can do well.

And so the case stands thus to the sugar planter of Louisiana. The State provides you with an opportunity to educate your sons for sugar work at a small cost and in a manner of proved excellence. If you give your sons this education, you ensure them a good livelihood, and give them in their business career every chance for success. These opportunities exist primarily for your sons. If you do not take advantage of them, you may rest assured that others will.—*Louisiana Planter.*

THE ESTIMATION OF TITANIC ACID IN SOILS AND VEGETABLE ASHES.

By Messrs. H. PELLET and C. FRIBOURG.

After numerous experiments we have arrived at two methods of estimating the percentage of titanic acid in soils and the ashes of plants.

The first is a rapid colorimetric method, based on the action of oxygenized water, and equally applicable in the examination of soils and ashes by varying the quantity of material tested. The colour-reaction produced in an acid solution of titanic acid by the reducing action of zinc is not sufficiently delicate as a direct test.

The second is a gravimetric method, the first steps of which vary according to the quantity of titanic acid supposed to be present, but having as a final result the precipitation of the titanic acid from a solution of the same in bisulphate of potash, of known acidity, and the purification of the resulting precipitate by fusion with carbonate of potash. The purity of the precipitate is further proved by means of the colorimetric reactions with oxygenized water or with zinc.

1. The Direct Colorimetric Method.

Let ·5 gram of the dry and finely ground soil, or 2·5 grams of vegetable ash, be introduced into a platinum capsule containing 15 grams of pure hydrofluoric acid. One c.c. of pure sulphuric acid (66 B) is then added and the whole evaporated to dryness. The residue, which can be easily detached from the capsule, is pulverized and mixed with 5 grams of bisulphate of potash (prepared by mixing the theoretical proportions of neutral sulphate and sulphuric acid), then fused. The fused mass is dissolved in distilled water containing 15 c.c. of pure sulphuric acid per 100 c.c., at a maximum temperature of 60° C. After cooling, the solution, which should now be clear, is diluted to 100 c.c.

From 1 to 10 c.c. are diluted to exactly 10 c.c. with distilled water, and then 5 c.c. of oxygenized water (containing 12 volumes of dissolved oxygen) added, and the liquid examined in a Josse Colorimeter against a standard solution containing from 0·1 to 1·0 gram of titanic acid per litre, whence the quantity of titanic acid in the sample solution is ascertained. Ten c.c. of the gram per litre solution, mixed with 5 c.c. of oxygenized water, gives a reading of from 600 to 700 in the colorimeter; the solution containing 0·1 gram per litre, under the same conditions, giving a reading of from 60 to 70.

2. The Gravimetric Method.

(*a*) For soils containing a minimum of 2% titanic acid.—3 grams of the dry and finely-ground soil are added in small portions to 30 grams of pure hydrofluoric acid contained in a platinum capsule. 3 c.c. pure sulphuric acid being added, the mixture is evaporated on a water bath, and the residue gently heated until completely dried without decomposing the sulphates formed. The contents of the capsule are now roughly crushed with a spatula, mixed with 15 grams of bisulphate of potash, and fused. After cooling, the mass is detached from the bottom of the capsule, coarsely powdered, and treated with from 200 to 250 c.c. of water at a temperature of 65 C. After cooling, the volume is diluted to 200 c.c., and the whole filtered in order to separate traces of sand (from 5 to 10 milligrams at most). 250 c.c. of the filtrate (representing 2·5 grams of the sample) are transferred to a beaker of 400 c.c. capacity. Of the remainder, 40 c.c. are titrated with a solution of potash of such strength that 10 c.c. neutralize 5 grams of bisulphate of potash. To the above-mentioned 250 c.c. of filtrate there are then added as much potash solution as will leave 5 grams of the bisulphate unneutralized. 50 c.c. of a freshly-prepared solution of sulphurous acid (1020–1025 density) are now added, and the liquid boiled for two hours. Whilst boiling, two additions of 50 c.c. of sulphurous acid are made. The boiled solution is then filtered, and the precipitate washed with boiling water and ignited. The ignited precipitate, consisting of titanic acid mixed with a little

phosphoric acid, is fused with 2 grams of pure carbonate of potash, the mixture treated with boiling water, and the insoluble residue filtered off and washed with a 2% solution of carbonate of potash. This residue consists of an almost insoluble titanate. But as a small quantity remains in the solution, this loss is ascertained by means of a blank experiment made with the same quantity of titanic acid.

The insoluble titanate is ignited and then fused with 1 gram of bisulphate of potash, dissolved in water and precipitated as before. Finally, the weight of the ignited titanic acid is increased by the amount lost during the aforesaid fusion with potassium carbonate, and the corrected weight calculated on to 100 grams of the original soil. The purity of the final precipitate is verified by the colorimetric method already described, or by means of the reaction with zinc by employing a sufficiently concentrated solution (about 5 parts of titanic acid in 1000).

(*b*) For soils containing less than 1% titanic acid.—Two portions of the finely ground soil, of 5 grams each, are ignited in separate platinum capsules until the organic matter is destroyed. To each capsule there are then added—10 grams of carbonate of soda, and ten grams of carbonate of potash, and the contents of each capsule mixed and fused. The residues are treated with dilute hydrochloric acid, the solution evaporated to dryness and gently ignited in order to render the silica insoluble, after which the residues are again treated with acid, the resulting solutions filtered, and the insoluble silica ignited. There are thus obtained:—1. The silica; 2. The hydrochloric acid solution.

The silica is treated with a mixture of hydrofluoric and sulphuric acids, leaving an insoluble sulphate-residue. The hydrochloric acid solution is made alkaline with ammonia, the precipitate produced being filtered off and dried in a hot-air oven; the filter paper alone being ignited.

The residue from the silica is now added to the dried ammonia precipitate and filter paper ash, and the whole fused with from 15 to 20 grams of bisulphate of potash. The subsequent operations are then repeated as under (*a*), making two intermediate fusions with carbonate of potash before the final fusion with bisulphate and precipitation as pure titanic acid. The purity of the precipitate is confirmed quantitatively by the oxygen test, and qualitatively by the zinc test.

(*c*) For vegetable ashes containing about 0·2% titanic acid.—50 grams of the ash are treated with dilute hydrochloric acid, evaporated to dryness, ignited, re-treated with the acid, and the silica separated by filtration. As under (*b*), there are then obtained:—1. The silica; 2. The hydrochloric acid solution.

The silica is treated as before, namely, with mixed hydrofluoric and sulphuric acids; fusion with bisulphate and precipitation; fusion with carbonate of potash; second fusion with bisulphate and

precipitation of the pure titanic acid; verification by the tests with oxygenized water and with zinc.

The hydrochloric acid solution is concentrated, and to it are added 0·5 gram of sublimated perchloride of iron and 20 grams of phosphate of ammonia. The liquid is then evaporated to dryness in a platinum capsule and ignited until the ammonium chloride is driven off. The residue, after cooling, is once more treated with dilute acid and the resulting liquid filtered. The insoluble matter on the filter is washed with boiling water, gently ignited, fused with carbonate of potash, and taken up in boiling water. The residue still remaining insoluble is fused with bisulphate of potash and, after solution, the titanic acid is precipitated. This is again fused with carbonate of potash, then with bisulphate and reprecipitated, by which treatment the titanic acid is obtained in a practically pure state, as verified by the tests with oxygenized water and with zinc.

The titanic acid found in the silica and the hydrochloric acid solution added together give the quantity present in the 50 grams of ash examined.

NOTE.—The treatment here adopted for the hydrochloric acid solution may be simplified by employing the method of precipitation adopted by Carnot for estimating alumina, namely, precipitation with phosphate and hyposulphite of soda from a solution containing hydrochloric and acetic acids, whereby the precipitate contains only titanic acid and alumina in the state of phosphates. By treating this precipitate with carbonate of potash, followed by fusion with bisulphate, the titanic acid may be more readily obtained in a state of purity.

CONCLUSIONS.

Dr. Maxwell has recorded 2·46% of titanium in Hawaiian soils. In the ooze of the Nile, which constitutes the arable land of Egypt, we have found about 2·0%. In the soil of Pas-de-Calais, we have only found 0·47% of titanium. To-day it is well known that all soils contain a greater or smaller quantity of titanic acid.

In the ash of sugar canes, Dr. Maxwell has found as much as 1·11% of titanic acid, whereas in the ash of Egyptian canes we have only found 0·17%, working with absolutely pure ash. The samples of ash analysed by Dr. Maxwell appear to contain traces of soil, as stated by him, so that his figures for titanium are evidently too high. We have found no titanium in the pure ashes of beets harvested in Pas-de-Calais, although the test used was sufficiently delicate to detect 0·01 of titanic acid in 100 parts of ash.—(Translated from the *Bulletin de l'Association des Chimistes*.)

[*Editor's Note.*—The above paper forms a supplement to the same authors' article on "The Mineral Constituents of the Sugar Cane," a translation of which appeared in the June issue of this Journal, p. 281.]

THE COLONIAL EXHIBITION AWARDS.

At the Colonial Exhibition, held this summer at the Crystal Palace, London, the following were amongst the awards in the West Indian Court:—

A special gold medal was offered for the best collective exhibits, and was won by the Jamaica Court with 97 marks out of a possible 100. Trinidad was second with 84, and Barbados third with 78.

Jamaica.—The local Committee secured a grand prize for its general exhibit, and a gold medal for its bananas. Col. the Hon. C. J. Ward, C.M.G., received a gold medal for sugar from his Monymusk Estate, Jamaica.

Trinidad.—Mr. R. Warren, St. Chas. Estate, received a gold medal for his Centrifugal Muscovado sugar; Mr. Norman Lamont, M.P., a gold medal for white crystals from his Palmiste Estate; Mr. W. Saunderson, Reform Estate, a gold medal for yellow crystals and molasses; and the New Colonial Co. Ld., a similar medal for grey crystals.

Barbados.—Mr. F. Brown, a gold medal for yellow crystal sugar; the Hon. F. G. Clarke, a gold medal for Centrifugal Muscovado and Massecuite. Eight other sugar exhibits likewise secured gold medals.

Mr. Algernon E. Aspinall secured a grand prize for his picture post cards of West Indian views.

Messrs. James Philip & Co., a gold medal for their collective exhibit of West Indian produce; and the Pure Cane Sugar Co., a gold medal for their "Phil Cane" sugars.

Messrs. Curtis, Campbell & Co., Messrs. Sandbach, Tinne & Co., and Messrs Booker Bros., McConnell & Co., were each awarded gold medals for their exhibits of molascuit.

From all accounts, the exhibition was a great success.

CONSULAR REPORTS.

France.

Dunkirk.—Sugar exports to the United Kingdom amounted to 34,637 tons, an increase of 10,051 tons compared with the preceding year. The retail price of loaf sugar at Dunkirk, which fell 2d. per lb. in September, 1903, rose ½d. in September, 1904, and a further halfpenny in March, 1905. The present price (May) for loaf sugar is 45 c. per ½ kilo. (about 3¾d. per lb.).

During the season 1904-05 up to March 31 the production of sugar in France amounted to 626,572 tons, a reduction of 141,870 tons compared with the preceding season. There was also a decrease in the production of alcohol from beet. At the end of February (first

five months of the season 1904-05) the quantity produced amounted to 18,250,000 gallons against 23,550,000 gallons in the preceding corresponding period.

The consumption of sugar, which increased very largely from September, 1903, has been falling very considerably. Comparing the eight months September to April, 1904-1905, with the preceding corresponding period, there has been a decrease of some 100,000 tons in the consumption of sugar in France.

It is estimated that there will be an increase of from 23 to 30 per cent. in the acreage under sugar beet in France, but the actual season (April-May) has been most unfavourable for sowing and for the growth of the seed, the temperature keeping so much below the average.

PORTUGAL.

Chinde.—The two companies engaged in growing sugar in the Zambesi Valley have had excellent crops last year (1904). The Companhia do Assucar de Mocambique has its plantations on the left bank of the river. It employs some 20 Europeans, 10 Goanese, and a number of natives, varying between 2,000 and 3,000 according to the season. In 1904 the output of sugar was 3,700 tons, nearly double that in 1903.

The Companhia de Exploracao de Fabrica de Marromeu was formed in 1903 to take over the properties of a company somewhat similarly named. It is established on the right bank of the Zambesi. The river is encroaching on the shore, and it will shortly be necessary to remove the buildings further inland. Their output of sugar in 1904 was 3,750 tons. It is not anticipated that it will be so much in 1905.

The Portugese Government encourages the sugar industry in its African colonies (Mocambique and Angola) by allowing a rebate of 50 per cent. off the import duty (120 reis per kilo.) levied on sugar entering Portugal. At the present rate of exchange, therefore, this sugar benefits to the extent of about £11 per ton. The quantity of sugar allowed to enter Portugal at half duty in this way is, however, limited to 6,000 tons from either colony. Sugar above that quantity pays the full duty.

The experience of years has proved that sugar thrives in the Zambesi lowlands near the river, and it is thought that cotton would do equally well there and in the lower Shiré district, where similar conditions of soil and climate obtain. Two cotton experts (one of whom came out for the Government of British Central Africa) have investigated the question of cotton growing in the latter locality, and their opinions are distinctly favourable.

WURTEMBURG.

The British Consul at Stuttgart reports:—

Under the head of sugar it may be mentioned that the wholesale dealers' association, which had been formed to combat the Sugar

Refiners' Trust was dissolved, as in consequence of the Brussels Sugar Convention the German sugar market entered on a stage of natural conditions of supply and demand. The export decreased from 11,800 to 8,790 tons, and home consumption increased from 7,700 to 11,300 tons.

Morocco.

Mogador.—The British Vice-Consul at Mogador reports that the imports of sugar during 1904 were as follows:—

Sugar, £90,000. From France, £73,000, and from Belgium £9,000 worth. As regards the large sugar trade (almost all French) it was stated in last year's report that it is regrettable the United Kingdom does not attempt to participate in it in any way, and that inquiries might with advantage be made about it. Only one request for information was, however, received at the Vice-Consulate on the matter.

Belgium.

The total exports of raw and refined sugar from Belgium to all countries amounted in 1904 to 184,965 tons, of a value of £1,981,032, thus showing a great increase over the exports of 1903, which reached only 116,655 tons during the latter year.

The exports to the United Kingdom alone increased during 1904 by 100 per cent., the actual figures being as follows:—

Year.	Quantity. Tons.	Value. £
1903	43,387	408,800
1904	86,483	937,600

This large increase in the export of sugar from Belgium to the United Kingdom was due to the cessation of the purchase of sugar from Russia and other bounty giving countries.

PUBLICATIONS RECEIVED.

We had occasion a short while ago to refer to the series of Picture Postcards of West Indian Views produced from photographs taken by Mr. Algernon E. Aspinall, the genial secretary of the West India Committee. They were issued with a view to popularising the West Indies. They have at any rate popularised themselves, for we learn that over 46,000 of them have been disposed of. Mr. Aspinall has therefore felt justified in issuing some new series, which include both new views and old ones. The printing is better than in the first series; and the old views are now shown in larger perspective, as they take up the whole surface of the card. This enlargement very much improves them, as under their original design the details of the pictures were rather too minute. This, of course, obliges one

to write the message on the address side; but it may be pointed out that while the postal regulations do not allow postcards for abroad to have the message on the address side, the penalty—classification as a letter—does not affect one in the case of mails for the British Colonies for the simple reason that the letter and postcard rates are identical.

The new series include—

Dominica—6 cards. West Indian Views—6 coloured cards.
St. Kitts—6 cards. Colonial Exhibition, 1905—6 cards.
Launch of R.M.S. *Arragon*—3 cards.

The cards are sold by Mr. George P. Osmond, 15, Seething Lane, London, E.C., to whom all applications should be addressed.

Correspondence.

FIVE-ROLLER MILLS.

TO THE EDITOR OF "THE INTERNATIONAL SUGAR JOURNAL."

Sir,—For "Demerara's" information I may state that the part played by my firm has been the construction of a very considerable number of such mills. They have ranged from 16 in. × 24 in. to 36 in. × 72 in., and are to be found at work in almost all cane sugar countries.

His implication that the invention of Messrs. Thomson & Black has served its day, and has been superseded, is met by the fact that the business done in it is constant and ever increasing.

"Demerara" cannot surely know his Demerara very well, or he would know that on the largest, and admittedly the leading, plantation there, the Thomson & Black crushers were installed only a few years ago, and are at work in front of both the old and the new trains of mills.

Regarding Campos he is far from being *au courant*, and of what is going on elsewhere in this type of mill he is plainly in oblivion; his title therefore to instruct your *few** readers is more than doubtful.

The merit of Thomson & Black's invention lay in a clever combination of a cane crusher with a cane mill, which "Demerara" admits was a step in the right direction, and experience proved to be an immense advance on the simple three-roller mill then generally in use. Any crusher combined with a three-roller mill might be called a five-roller mill, and although a crusher is now generally followed

* There was a slight printers' error in "Demerara's" letter appearing in our last issue which entirely altered the meaning of a sentence. In the first line of the second paragraph an unauthorized comma was inserted after "readers." It should have read "few readers who are not aware," a very different definition. The supposed slight is therefore not really "Demerara's" fault.—[*Ed. I.S.J.*]

by several ordinary mills, the point is that high extraction cannot be attained without a crusher, no matter how many ordinary mills the train comprises.

If "Demerara" thinks that the Thomson & Black five-roller mill is exploited as a complete apparatus for juice extraction, he is much mistaken; those associated with it never claimed finality for it; they advocated it merely as the best form of mill for the first treatment of sugar canes, and although even after fully twenty years it has not become universally popular, it has been far more extensively adopted than "Demerara" is aware of, or its inventors ever expected, and the fact that no cane mill is now considered complete without a crusher is largely the result of their having shewn the right way in the early eighties.

Other designs of crushers have come on the market since then (like certain fancy evaporators, diffusors, and clarifiers), but as a device for breaking down sugar canes and forming them into a mat suitable for treatment by the grinding rollers, the Thomson & Black crusher has still an enviable virility in spite of what your correspondent insinuates from behind a *nomme de guerre.*

Besides improved extraction, something favourable to the Thomson & Black design might be mentioned regarding the kind of megass resulting from various types of crushers, but your space is limited, and I must stop now in the hope that "Demerara" may also find this reply "interesting and instructive."

I remain, yours faithfully,

J. Mc.Neil.

(This correspondence is now closed.—[*Ed. I.S.J.*])

MONTHLY LIST OF PATENTS.

Communicated by Mr. W. P. Thompson, C.E., F.C.S., M.I.M.E., Chartered Patent Agent, 6, Lord Street, Liverpool; and 322, High Holborn, London.

ENGLISH.—Abridgements.

21865. J. R. Hatmaker, Paris, France. *Improvements in process of obtaining milk sugar and casein from milk.* 11th October, 1904. This invention relates to milk sugar which is commonly obtained by slowly evaporating the water contained in whey, or that watery liquid of milk which remains after the butter fat and the casein have been removed. Such liquid contains some 95 % of water, and its slow evaporation is not only inconvenient and costly, but destructive of a considerable portion of the sugar.

22639. J. R. Hatmaker, Paris, France. *Cacao, sugar, and milk compound, in dry flaky form.* 20th October, 1904. This invention

relates to dry homogeneous compounds of cacao, sugar, and milk, in light, flaky form, obtained by drying liquid solutions of cacao, sugar, and milk.

23579. A. G. FISCHER, West Kilburn, N.W. Middlesex. *A combined self-operating sifter and graduator for sugar and the like.* 1st November, 1904. This invention relates to a combined sifter and graduator for sugar and the like, comprising a bin to receive the sugar or other material, having a sloping bottom with a grid or grating in the centre thereof, a movable slide immediately above or below said grid or grating, a series of sieves of different gauge or meshes underneath said slide, a rotating disc supporting receptacles to receive the sifted and graded material, shoots or spouts to convey the sifted and graded material to the said receptacles, and means for vibrating the sieves distributing plate and shoots.

8859. J. MCNEIL, Govan, Lanark, North Britain. *Improvements in dumbturners for sugar cane mills.* 27th April, 1905. This invention relates to a dumbturner device for sugar cane mills, comprising a dumbturner bar and a supporting beam therefor, arranged between the inner faces of the housings of the mill, carried upon stools formed on the inner surface of the said housings or fixed within and between them, and provided with means for adjusting and securing bar and beam in position; bar and beam and their supporting and adjusting devices being arranged so as to avoid the necessity for apertures, in the housings, between the rolls.

GERMAN.—ABRIDGMENT.

162995. A. WOHL and Dr. ALEXANDER KOLLREPP, of Charlottenburg. *A process of converting raw sugars, by-products, and molasses of the beetroot sugar manufacture into consumable syrup.* 14th November, 1903. In this process the products freed from the volatile acids in the ordinary way by boiling in acid solution, are subjected to a further purification with lead sacchrrate or another insoluble basic lead or zinc compound.

NOTE.—Copies of all published specifications with their drawings in these lists can be obtained from W. P. Thompson & Co., 6, Lord Street, Liverpool, at One Shilling a copy for English or American Patents, and Two Shillings for German. In ordering please give number and date.

IMPORTS AND EXPORTS OF SUGAR (UNITED KINGDOM)

To end of September, 1904 and 1905.

IMPORTS.

Raw Sugars.	Quantities.		Values.	
	1904. Cwts.	1905. Cwts.	1904. £	1905. £
Germany	4,752,046	3,769,613	2,146,973	2,204,850
Holland	227,412	91,610	111,978	63,722
Belgium	348,867	308,929	160,199	222,438
France	437,832	236,493	227,008	155,320
Austria-Hungary	683,432	370,920	307,428	243,766
Java	1,431,822	1,928,466	636,742	1,316,260
Philippine Islands	86,650	9,680	31,025	4,840
Cuba	....	....	....	....
Peru	839,506	995,924	391,730	657,278
Brazil	82,317	87,414	31,176	47,958
Argentine Republic	....	....	....	....
Mauritius	495,357	158,460	186,011	87,369
British East Indies	189,821	412,177	76,756	232,199
Br. W. Indies, Guiana, &c.	824,521	901,137	533,439	725,664
Other Countries	419,849	733,729	194,449	494,337
Total Raw Sugars	10,819,426	10,014,552	5,034,914	6,456,001
Refined Sugars.				
Germany	8,270,042	7,205,568	4,690,425	5,767,161
Holland	2,370,350	1,180,115	1,422,314	972,212
Belgium	367,751	189,478	212,967	155,639
France	2,105,017	1,491,796	1,185,416	1,102,102
Other Countries	171,945	344,392	91,035	289,051
Total Refined Sugars	13,285,105	10,411,349	7,602,157	8,279,165
Molasses	1,336,620	1,874,108	245,177	373,808
Total Imports	25,441,151	22,300,009	12,882,248	15,108,974

EXPORTS.

British Refined Sugars.	Cwts.	Cwts.	£	£
Sweden	2,467	184	982	168
Norway	23,386	15,624	12,824	11,969
Denmark	86,282	63,832	44,037	45,643
Holland	47,834	58,388	25,752	45,044
Belgium	8,876	6,595	4,827	4,291
Portugal, Azores, &c.	12,944	11,419	6,975	8,329
Italy	3,238	4,965	1,515	3,253
Other Countries	259,988	251,296	168,439	218,790
	445,015	412,303	265,351	337,496
Foreign & Colonial Sugars.				
Refined and Candy	19.992	19.323	13,805	16,640
Unrefined	91,260	73,435	50,434	51,818
Molasses	1,835	2,752	1,022	840
Total Exports	558,102	507,813	330,612	406,794

UNITED STATES.

(Willett & Gray, &c.)

(Tons of 2,240 lbs.)	1905. Tons.		1904. Tons.
Total Receipts, Jan. 1st to Oct. 19th ..	1,629,677	..	1,638,375
Receipts of Refined ,, ,, ,, ..	1,233	..	564
Deliveries ,, ,, ,, ..	1,553,637	..	1,639,643
Consumption (4 Ports, Exports deducted) since January 1st	1,475,630	..	1,546,522
Importers' Stocks October 18th	76,040	..	10,893
Stocks in Cuba, October 25th	139,000	..	5,043
Total Stocks, ,, ...	220,000	..	159,099
	1904.		1903.
Total Consumption for twelve months ..	2,727,162	..	2,549,643

CUBA.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1904 AND 1905.

(Tons of 2,240lbs.)	1904. Tons.		1905. Tons.
Exports	1,042,177	..	884,984
Stocks	47,558	..	212,777
	1,089,735	..	1,097,761
Local Consumption (eight months)	27,860	..	28,120
	1,117,595	..	1,125,881
Stock on 1st January (old crop)	94,835	..	—
Receipts at Ports up to 31st August ..	1,022,760	..	1,125,881

Havana, August 31st. 1905.　　J. GUMA.—F. MEJER.

UNITED KINGDOM.

STATEMENT OF IMPORTS, EXPORTS, AND CONSUMPTION FOR NINE MONTHS ENDING SEPTEMBER 30TH.

SUGAR.	Imports. 1903. Tons.		Imports. 1904. Tons.		Imports. 1905. Tons.	Exports (Foreign). 1903. Tons.		Exports (Foreign). 1904. Tons.		Exports (Foreign). 1905. Tons.
Refined	761,840	..	664,255	..	520,567	1,695	..	1,000	..	966
Raw	482,739	..	540,971	..	500,727	2,423	..	4,563	..	3,672
Molasses	57,299	..	66,831	..	93,705	71	..	92	..	138
Total..........	1,301,878	..	1,272,057	..	1,114,999	4,189	..	5,655	..	4,776

	Home Consumption. 1903. Tons.		1904. Tons.		1905. Tons.
Refined	707,812	..	675,444	..	525,117
Refined (in Bond) in the United Kingdom	296	..	392,207	..	406,021
Raw	395,051	..	98,697	.	79,365
Molasses	51,015	..	58,202	..	86,238
Molasses, manufactured (in Bond) in U.K.	178	..	44,362	..	39,025
Total	1,154,352	..	1,268,912	..	1,135,766
Less Exports of British Refined....................	34,711	..	22,251	..	20,615
Total Home Consumption of Sugar	1,119,641	..	1,246,661	..	1,115,151

STOCKS OF SUGAR IN EUROPE AT UNEVEN DATES, OCT. 1ST TO 25TH, COMPARED WITH PREVIOUS YEARS.

IN THOUSANDS OF TONS, TO THE NEAREST THOUSAND.

Great Britain.	Germany including Hamburg.	France.	Austria.	Holland and Belgium.	TOTAL 1905.
111	145	253	55	27	592

	1904.	1903.	1902.	1901.
Totals	1773	1161	1123	524

TWELVE MONTHS' CONSUMPTION OF SUGAR IN EUROPE FOR THREE YEARS, ENDING SEPTEMBER 30TH, IN THOUSANDS OF TONS.

(Licht's Circular.)

Great Britain.	Germany.	France.	Austria.	Holland, Belgium, &c.	Total 1904-5.	Total 1903-4.	Total 1902-3.
1581	878	594	450	168	3672	4138	3586

ESTIMATED CROP OF BEETROOT SUGAR ON THE CONTINENT OF EUROPE FOR THE CURRENT CAMPAIGN, COMPARED WITH THE ACTUAL CROP OF THE THREE PREVIOUS CAMPAIGNS.

(From Licht's Monthly Circular.)

	1905-1906. Tons.	1904-1905. Tons.	1903-1904. Tons.	1902-1903. Tons.
Germany	2,175,000	1,595,100	1,927,681	1,762,461
Austria	1,420,000	889,400	1,167,959	1,057,692
France	950,000	622,100	804,308	833,210
Russia	1,060,000	950,000	1,206,907	1,256,311
Belgium	325,000	173,800	203,446	224,090
Holland	200,000	136,500	123,551	102,411
Other Countries .	420,000	340,000	441,116	325,082
	6,550,000	4,706,900	5,874,968	5,561,257

THE

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☞ The Editor is not responsible for statements or opinions contained in articles which are signed, or the source of which is named.

NOTES AND COMMENTS.

In this number will be found a long and valuable paper by Mr. H. C. Prinsen Geerligs, of Java, on the influence of soda salts in the soil on the constitution of sugar cane. He shows that while the sugar cane will only assimilate soda as a last resource, yet the presence of such salts leads to various combinations with potash, lime, and magnesia, placing these latter elements at the disposal of the plants. As so many of our Colonial cane growing districts are in close proximity to the sea shore, this question of saline influence should prove instructive to many of our readers. Another paper we give is a rejoinder of Dr. Horne, of New York, to the criticisms passed on his method of sugar analysis by Messrs. H. & L. Pellet, in the paper which we translated last month from the *Bulletin des Chimistes*. The problem of the Polarimetric Determination of Sugar has led of late to much argument among the experts, and so far there seems no early prospect of an agreement being arrived at It will, however, be interesting to have before one a summary of the controversy, and of the views held by the respective British, French, and American expert chemists. We therefore hope next month to place before our readers such a summary, which will be found of use by those who have not had either the time or the expert knowledge to follow the controversy in all its bearings.

The Brussels Permanent Commission.

The Brussels Permanent Commission, which met on October 23rd last, investigated the situation in those countries, the consideration of whose sugar régime had been deferred at the previous sitting. The case of Brazil was again deferred till next March, to allow of further enquiries. The countervailing duties previously fixed in the case of Bolivia, Honduras, Guatemala, Paraguay, and the Philippines, were suppressed. It was, however, decided that Nicaragua gave bounties, and the countervailing duties previously fixed for this country were maintained. This will result in the prohibition of the entry of Nicaraguan sugar into the United Kingdom.

A German View.

On another page we give a translation of some remarks made by the *Deutsche Zuckerindustrie* on the attitude of English politicians towards the Brussels Convention. We are glad to see our contemporary lending its aid to demolish one of the fallacious assertions of the sugar users. It is, however, somewhat concerned as to the attitude of the next Liberal Government towards this international measure. Will the Liberals take the first opportunity of denouncing the Convention? We think the *D.Z.I.* may rest assured that this question will not attain the prominent position in the next Liberal programme that the hub-bub created by the sugar users would lead one to expect. Recent political developments encourage us in the belief that if the Liberals do come into power, they will have far more important and more controversial questions to occupy their attention. The Home Rule spectre, church and educational reforms, and the fiscal problem will give them enough to do, and will, so we hope, prove enough to ensure their early downfall. But, obviously, if we have further crop failures, resulting in an increase in sugar prices by 50%, the danger will be much enhanced, as a strong anti-convention party might conceivably come into existence, and carry the Government with it. If, however, prices keep down to 10s., there should not be much cause for anxiety.

Sugar Beet Growing in Lincolnshire.

Plans for the establishment of a beet sugar industry in Lincolnshire seem to be so far advanced that a site for a central factory has been secured. This is in the Isle of Axholme, on the banks of the Trent. The soil of this isle is very rich, and yields magnificent crops of wheat, potatoes, and mangel wurtzel. Some three thousand acres of land are available, and are expected to produce 60,000 tons of roots. A capital of £60,000 will be required, and a fixed rate of interest will be paid, the balance to be divided among growers and employees on the co-operative system. Needless to say, Mr. Sigmund Stein is a moving spirit in this enterprise, and if the latter fails it can hardly be from want of trying. We shall follow the development with interest,

and wish it a successful issue. We hope, by the way that it will be found possible to get most of the machinery, needed for this new factory, in the United Kingdom; but obviously the success of this new venture must not be jeopardized by the selection of possibly inferior designs of home made plant. The best of everything must be chosen irrespective of its origin.

Peru.

A correspondent, in Peru, writes to us as follows :—

Peru is certainly a sugar growing country, and many of its characteristics as such are unique. All its conditions are conducive to heavy production, and in some respects it resembles the dry or heavy producing districts of Hawaii. Where sugar is now grown in Peru, it is grown under irrigation. Grinding can be continued throughout the year; in fact, one estate claims that they have not shut down for extensive repairs for six years. At Cartavio they have been able to recover an average of about 4½ long tons of sugar per acre; with fully equipped modern machinery this would be somewhat higher. On a piece of land of 85 acres, 79·8 long tons of cane per acre, carrying 14 to 15% sugar, have been grown. The canes generally contain a rather high percentage of sugar, 13 to 16%, and high fibre, 12 to 16½%. The juices are generally of high density, high sugar content, and good purity; as high as 23 Brix has been observed, and sucrose 21; more often, however, the juice will register 20 Brix, and 18 sucrose; in exceptional cases we have noted the sucrose in the juice as low as 15.

The recent good prices of sugar have encouraged a renewed interest in the sugar industry here, and have caused an extra activity in the development of some of the estates.

One of the chief problems for the advancement of the sugar industry in Peru, is the development and conservation of the water supply. Artesian wells have been sunk near Lima, and have so far given a good flow. The rivers or streams from which the irrigation water is taken are periodic; in the flood season there is a superabundance of water, while in the short season the supply is very limited. One way of increasing the available water supply would be the conservation of the water during the flood season.

Peru's output of sugar has been gradually increasing. I have just been able to get together figures relative to the exportations of sugar from 1896 to 1904 inclusive, as follows :—

	Metric Tons.		Metric Tons.		Metric Tons.
1896 ..	71,735	1899 ..	103,706	1902 ..	117,361
1897 ..	105,463	1900 ..	112,222	1903 ..	127,673
1898 ..	105,713	1901 ..	114,637	1904 ..	131,975

The total output of sugar, including chincaca, is now something probably over 140,000 tons annually.

Basket Sugar.

In the Miller process of making basket sugar, the glucose is recovered with the sucrose in the dry sugar powder. The whole of the sugars is recovered in one operation, and there is no molasses produced. The main difference from other processes lies in the use of a pan provided with an oil space between the fire and the boiling sugar. This prevents the sugar from burning while the heat is sufficient to finish a strike in from 15 to 20 minutes.

Increased Import Duties in Chile.

A bill, which is passing through the Chilean Parliament, proposes to increase the import duty on granulated sugar (first product or unrefined, moist or dry) by 20 centavos per 100 kg. (1·83d. per cwt.) annually, until the duty stands at 7 pesos 70 centavos per 100 kg. (5s. 10½d. per cwt.). Other unrefined sugars will pay the same increase.

The Egyptian Refineries Company.

It will be remembered that the Egyptian Refineries Company were heavily hit by the failure of M. Cronier. Their affairs have as a consequence been investigated by the Courts in Cairo. The latter appointed a Commission, headed by Sir William Willcocks, to carry out the task, and these gentlemen went on a tour of inspection over the factories and plantations of the Company. According to the Report they have issued, the cane cultivation has been carried on in so amazing a manner that immense losses have been incurred year after year. The Commissioners have apparently come to the conclusion that it requires unusually favourable conditions of situation, soil and climate to enable the sugar cane to make headway against the spread of cotton-growing in Egypt. Sir William Willcocks states that to keep the refineries of the Company in active working twenty-two million cantars of sugar cane are required annually, representing the product of 42,500 acres; the output of refined sugar would then be two million cantars. But 40,000 acres of sugar plantations he considers beyond the competence of a single management. Therefore he recommends a restriction of the acreage to be planted, and points out the necessity of securing Government co-operation, and particularly the remission of the present special Government tax, if the industry is to flourish in the future.

Some West Indian sugar canes, which were used to decorate the courts at the recent Colonial Exhibition in London, after being erected for two months, were seen to be covered with a thick growth of "rind fungus" so much so as to blacken the hands whenever they were touched.

THE WORLD'S INVISIBLE PRODUCTION OF SUGAR.

Our statistics are confined to those countries from which information more or less accurate can be obtained, of production, exportation, and consumption. But these statistics very properly omit to mention the large sugar production of British India, though they give the small exports to the United Kingdom, chiefly, if not wholly now, from Madras. It is true that one of the leading statisticians in Germany attempted to revolutionize our world's statistics by adding a lump sum of two million tons to the production and consumption columns, under the new heading of British India. This created great confusion, especially at a time when the agitating confectioner had set all our politicians at work over sugar statistics. Public men became bewildered when they read in one place that the world's consumption and production was about 11,000,000 tons, and in another that it was 13,000,000 tons. Throwing statistics at each other's heads is confusing enough even under the most favourable circumstances, but with an extra two million tons occasionally thrown in and taken out again the controversy became unintelligible. Mr. Licht was begged to come to the rescue and restore his figures to their former limits, and we may hope that in future the confusion will be eliminated.

It is, nevertheless, interesting to study the extent of this "invisible" production outside the statistical barrier, and recent official figures enable us partially to raise the curtain and look within. It seems that a rough estimate is made, even in such vast regions as those of British India, of the number of acres planted with sugar cane. Here are the average yearly figures for the five years ending 1903-4.

Total crop 2,470,000 acres. Details :—

	Per cent. of crop.		Acres.
United Provinces..	48·1	=	1,188,070
Bengal	29·6	=	731,120
Panjab	13·6	=	335,920
North-west Province	1	=	24,700
Madras	2·5	=	61,750
Other parts (?)	5·2	=	128,440
			2,470,000

This year the United Provinces are estimated to have planted five per cent. less than in 1904, when the acreage was 1,243,000 acres. This would give 1,180,850 acres for 1905.

Bengal appears to have planted 622,300 acres against 628,800 in 1904; Panjab, 204,600 against 325,500 in 1904; the North-west Provinces, 24,800 against 25,900 in 1904; and Madras, 51,400 acres,

which is said to be an increase of 7,200 acres or 16 per cent. as compared with the corresponding date of last year, and 5,700 acres or 12 per cent. above the average of the preceding five years. This, as will be seen by the foregoing table, does not agree with the figures worked out from the official data, which show an average acreage for the five years ending 1903-4, of 61,750 acres in Madras, considerably in excess of the figure given for 1905.

The reduced acreage in the United Provinces, and in Bengal and Panjab, is due in part to destruction of seed cane by frost in the winter, and in part to deficient rainfall during the growing period.

No attempt is made to estimate the weight of sugar produced from 2,470,000 acres of sugar cane, and therefore it is worse than useless to attempt to add the British Indian sugar crop to our statistics of the world's visible production. There is no such thing as "visible" production there. With the exception of the small and intermittent exports of Madras sugar all the sugar produced in India is consumed in the country, most of it in the neighbourhood of its growth. Much of the sugar cane is not made into sugar at all. The juice is consumed as it flows from the cane, just as a stick of barley sugar is consumed.

No one can say whether an acre of land yields a ton, or half a ton, or two tons of sugar. It is certain that the methods of extraction and boiling are very primitive, and that the agriculture is not quite what could be called high farming.

India must therefore remain outside our statistics of production and consumption until the happy time comes when the sugar districts of India are covered with central factories, light railways, and all the other contrivances of modern science. India will then be a great producing country, German granulated will disappear from her markets, and ships may perhaps even load Indian granulated for Europe. More likely for China.

ENGLAND AND THE BRUSSELS CONVENTION.

Under the above heading the *Deutsche Zuckerindustrie* discusses the question of England's connection with the Brussels Convention, and the animosity shown to it by certain parties in this country. Our contemporary writes:—

"A short while ago a report was circulated through the press that England was the only country which was benefiting from the Brussels Convention. This report was somewhat contradictory to another declaration, almost in the same breath, that on the English side every effort was being made to prevent any further extension of the penal clauses, as was shown by the debates at the last meeting of the Permanent Commission. England, they said, was intending at

the earliest opportunity to denounce the Convention, and questions were being put to Members of Parliament and Parliamentary candidates as to whether they would oppose its renewal or not. But what are the real facts? We have on several previous occasions had to draw attention to the agitations got up by certain parties. These partisans were composed in the main of persons belonging to the sugar using industries, and we have likewise several times already given the grounds on which these opponents of the Convention based their attacks. As is often the case in commercial life, they have simply confounded cause and effect. Prices rose subsequent to the coming into force of the Convention, consequently they must have risen because of that measure! So ran the argument at the beginning of this year when the Liberals, in the House of Commons, submitted an amendment to the address which spoke in denunciatory terms of the Convention. One would have expected that now when prices are below those of September, 1903, the opponents of the Convention would have to search for fresh arguments. But, as far as we can ascertain, this is not the case; instead, we have the reiteration of the assertion that the speculations which led to a rise in prices were not caused by the short crop, but were primarily the result of the Convention banning the entry of Russian, Spanish and Argentine sugars into the English market . . . . ."

"It is, however, surely a testimony to the meagre knowledge held regarding the history and character of these speculations that one can maintain, as did Mr. George Mathieson in an argument with Mr. George Martineau in the *Standard* newspaper, that Cronier only entered on his speculations as a consequence of the Convention, and that so long as the latter was in force other speculators would, whenever the chance offered itself, play the same game, and, profiting from the experiences arising from Cronier's ultimate failure, carry it out more successfully. Now, attempts have been made to corner the market before the Convention came into existence; one has only to hark back to 1889. If the crash of that year was perhaps not so great as the one of last summer, this was solely due to the fact that the speculators of that time had not the same means for carrying on operations to such an extent as had Jaluzot and Cronier, thanks to the inconceivably high credit they possessed. In spite of these arguments being as threadbare as can be imagined, they have succeeded in exercising a wide influence in England, and it is not beyond the bounds of possibility that in the event of a change in Parliamentary representation, and the accession of the Liberal Party to power, the renewed attacks made by the Liberals in Parliament against the Convention will receive support from the new Cabinet. It is true, the answers given by the more competent Liberal candidates to the questions put by the above-mentioned organ of the sugar users allow no judgment to be formed as to their future attitude in this

matter. Again, under the influence of the present low prices, there is an increase in the number of those who are disposed to await further developments, and who thereby approach more nearly the standpoint of the supporters of the Convention, who ask for the further exercise of reasonable patience since, as the *Times* put it, no reliable judgment on the effects of the Convention is yet available, because the 1903-04 season followed too closely upon the date when the Convention became effective, and the 1904-05 season has been of too exceptional a character to admit of a fair unbiassed judgment."

THE POLARIMETRIC DETERMINATION OF SUGAR.

By Dr. W. D. Horne.

In the September number of the "Bulletin de l'Association des Chimistes," &c., Messrs. H. and L. Pellet discuss Messrs. Watts and Tempany's article upon the influence of the lead precipitate upon the polarization of sugars. Messrs. H. and L. Pellet do not agree with Messrs. Watts and Tempany in their recommendation of Horne's method of defecation of raw sugars with dry subacetate of lead in spite of the wonderfully close agreement obtained by these gentlemen, between the polarizations calculated from the ordinary polarizations with lead solution and the volume of the precipitate, and the polarizations as actually obtained by the defecation with dry subacetate of lead.

I have read the criticisms of the dry lead defecation with great interest and feel that every one of those advanced by Messrs. H. and L. Pellet can be successfully met. It is true that certain objections may be raised to the use of lead salts in general, but so long as nothing better can be found lead salts will be used, and I advocate the use of anhydrous subacetate of lead as an improvement upon the solution.

Messrs. Pellet's objections may briefly be stated to be:—

1. Sugar is occluded in the precipitate, lowering the polarization.
2. The organic matter separated by sulphuretted hydrogen from an original lead precipitate and afterwards precipitated by means of lead subacetate in a pure sugar solution does not increase the polarization so much as one would calculate from the determined volume of the original precipitate.
3. It is not a new process.
4. Anhydrous subacetate of lead is of uncertain composition.
5. It is not always dry.
6. It is difficult to avoid using an excess.
7. Only part of it acts, the rest passes into solution, increasing the volume of the solution and diminishing the polarization.

To take these points up in order I would point out:—

1. Only a very slight amount of sugar can be found in the lead precipitate after removing that which is freely soluble in water. Thus a precipitate obtained by adding sub-acetate of lead solution to a residual syrup obtained in refining cane sugar was washed with cold water until it gave only a faint re-action with alpha-naphtol. This precipitate when dried contained 71·29% lead and 28·71% organic and other matters. The concentrated organic solution obtained by decomposing 5·5163 gms. of this precipitate with sulphuretted hydrogen, filtering and concentrating to 200 cc. was then tested for sugar with alpha-naphtol in comparison with dilute sugar solutions of known strength and found to correspond with a solution known to contain $\frac{1}{20}$ of 1% of sugar. The organic solution then contained an amount of sugar equal to $\frac{1}{20}$ of 1% of 200 cc. or 0·1 gm. This found in 5·5163 gms. of the precipitate = 1·813% of the weight of the precipitate. In a sugar requiring 0·35 gm. of dry lead subacetate for defecation as used by Messrs. Watts and Tempany in treating muscovado sugars, one would obtain an organic lead precipitate weighing probably not over 0·423 grams. If this precipitate occluded an amount of sugar equal in weight to 1·813% of itself, this sugar would weigh ·007669 grams, and would cause a corresponding loss in polarization of 0·02950, an amount only about $\frac{1}{10}$ of the elevation of the reading commonly caused by the volume of the precipitate in this class of sugars, and far less than can be read on the polariscope.

2. Messrs. Pellet observe that when the original precipitate is weighed and its specific gravity determined to find its volume, it will be found on decomposing it with sulphuretted hydrogen, filtering, concentrating the organic solution and adding a known quantity of this solution to a known quantity of pure sugar solution, precipitating with lead subacetate, filtering and polarizing, the increase in polarization of the pure sugar solution will not be so great as one would calculate from the determined volume of the original lead precipitate.

To me this seems a faulty kind of argument; for the lack of accord between the first simple process and the second complicated process cannot be held to invalidate the first unless one can prove that there is nothing wrong with the second. It is altogether likely that the organic matter of the original precipitate is considerably modified by the treatment with sulphuretted hydrogen and the process of evaporation at elevated temperatures. Indeed, such is most plainly the case, for the original precipitate, above-mentioned in my experiments, had a specific gravity of 4·650 while that obtained by decomposing this with sulphuretted hydrogen and filtering, concentrating on a water bath and reprecipitating with more subacetate of lead solution had a specific gravity of 5·562 showing that the organic matter had radically changed. The organic matter in the second precipitation has a greater combining weight than in the first, indicating that the lighter acid radicals have been diminished. This

evidently takes place at least to a considerable extent during concentration, for 25 cc. of the above organic solution left a residue of ·0741 grams upon evaporation to dryness, while the same quantity, previously rendered neutral to phenolphthalein by $n/10$ caustic soda, left on evaporation a residue of ·1095 grams after calculating off the weight of sodium introduced. According to the analysis of the original precipitate the residue left on evaporation should equal ·1980 gm.

3. As to the process having been described before, I would merely say that I was quite uninformed of that fact until I read Messrs. Pellet's article. A good process is often discovered but afterwards abandoned or not generally applied because of some unfavourable circumstances at the time—to be re-discovered and taken up later when conditions are more favourable. This seems to have been the case in the present instance, because the former difficulties described by Messrs. Pellet (4) in obtaining a dry subacetate of lead of constant composition have now been successfully overcome by the firm of Baker and Adamson of Easton, Pa., chemical manufacturers, who have now for the past two years been manufacturing on a large scale a very pure anhydrous subacetate of lead of the constant composition $3Pb(C_2H_3O_2)_2 \cdot 2PbO$. A trial of this substance will convince anybody of its utility. This substance is further to be counted upon for dryness The samples I have analysed have contained from ·04 to about 2·0% of moisture in the highest case. Now, even 2·0% is negligible for if ·35 gram of the salt were used containing 2% of water this would be only ·007 grams of water in 100 cc., which would exercise absolutely no appreciable effect upon the polarization.

6. I have never found it difficult to avoid adding an excess, for an excellent clarification is effected well before an excess had been added, and it is very easy to see each time a pinch of the dry powder is added to a sugar solution exactly what the degree of precipitation is, and to stop when one sees that the lead salt begins to give only a faint precipitate.

7. Adding it thus, there is no salt dissolved without being immediately reprecipitated, a point proved by the absence of lead in the filtrate from the lead precipitate.

Having thus met the various questions raised, I trust this process of dry defecation may receive the attention its excellence deserves and prove of usefulness to the sugar world at large.

The recent Colonial Exhibition at the Crystal Palace has not resulted in any financial loss. A balance of almost £9 is shown in the final accounts.

The income of the New Colonial Company for the four years ending 1901 amounted to an average of £77,000 per annum. During the three Cartel years, however, the average was only £20,300. These figures speak volumes as to the effect of the Cartels on prices.

THE LATE MR. JAMES DUNCAN.

Mr. Duncan, who died in August while on a visit in Scotland, represented the noblest type of capitalist and employer, and his connection with the Victoria Dock district must always be remembered. Born seventy-one years ago, son of a Glasgow bookseller, Mr. Duncan entered the sugar trade as a boy of eleven, and his career for many years was one of marvellous success. The sugar factory at Greenock in which he was a partner started a refinery at Clyde Wharf, Victoria Docks, about 1860, and a few years later Mr. Duncan became the sole owner of these works. For twenty years the tide of fortune rose, and it is said that his profits during that time were £100,000 a year. He bought two estates on the Clyde—Benmore and Kilmun—and gathered a priceless collection of pictures. About 1869 he built a beet sugar factory at Lavenham, in Suffolk. The farmers sent in their roots, the syrup being forwarded to Clyde Wharf and there made into sugar. His desire was to benefit English farmers, as German farmers had already been benefited by this industry. But the farmers would not grow enough roots for a fair season's working, and other local difficulties were placed in his way, so after two or three years he gave up the enterprise. In 1884 the tide of prosperity began to turn. The foreign bounties were more than he could stand against. Germany, France, &c., were sending in sugar below cost price, and making their own people pay the deficiency. For the English people in general this was good, but to the English sugar refiner it spelt ruin. In four years Mr. Duncan had lost his all. Clyde Wharf was closed, and I well remember the tragic distress that this caused. His two estates were sold, and his pictures which fetched £30,000. He had enough left for his simple wants, and for twenty years he had been in retirement, spending his winters at San Remo and his summers in Scotland, contented and happy. For he had always lived in thought and aspiration apart from his money; he had paid every penny that he owed and his reputation as a Christian gentleman stood as high as ever. This retiring, somewhat shy Scotch bachelor, whom many of us remember so well, was one of the most generous men who ever set foot in the district. I am credibly informed that he gave away £20,000 a year during the whole period of his success. This, of course, went to all parts of the country, but a large portion of it was given away in the dock district. He was a Congregationalist, a member of Dr. Alexander Raleigh's Church at Highbury (where he lived), but in the dock district he gave impartially to all. "Any spiritual life is better than none," he seemed to say, as he handed over his thousands to the Church of England, the Roman Catholics, and all sorts of Nonconformists. He built the Presbyterian and the Congregational Churches in Victoria Dock Road, and for many years paid the best part of the stipends of the ministers. Mr.

Duncan found the dock district, when he entered it, in a hopeless state of neglect. He was soon paying a doctor £300 a year to attend his men, and organising sick relief for the whole district. Before there was any demand in the country for shorter hours of labour he reduced the time of the men who had to work in a hot temperature to eight hours a day, and directly the mechanics asked for a fifty-four hour week he granted it. For many years his workmen and their families had a day at the seaside at his expense. The party usually numbered three thousand, but there was never an accident. Once a year the foremen and leading hands had a supper, at which Mr. B. E. R. Newlands, the manager, presided, and Mr. Duncan would sometimes attend and deliver a genial speech. There is no doubt that Mr. Duncan, in his period of prosperity, meant to leave his estates on the Clyde as public recreation grounds. He never announced this, but casual remarks that he dropped pointed to it. The grounds were always freely open to the public, and the picture gallery as well. He was a personal friend of C. H. Spurgeon, who often spent his summer holiday at Benmore, and preached to the visitors and townsfolk. In the sixties and seventies there were no settlements, no special agencies in the dock district. The people who lived there had to get up for themselves all the movements that took place. And, always, as I well remember, "a subscription from Mr. Duncan" was reckoned upon as the start, and never failed to come. His name deserves to be remembered in honour and gratitude.—J. Spencer Curwen, in "Mansfield House Magazine."

The above touching memory of my old and valued friend has an interest for all who were readers of "*The Sugar Cane*" in bygone times. James Duncan was easily first among our sugar refiners, and indeed among all sugar experts. The British Sugar Refiners' Committee, founded in 1872, had for its chairman during its first years of hard work that remarkably able man, A. W. Gadesden. When he retired, James Duncan went to the helm and steered the ship for many years with much energy and skill. The members of the Committee, from London, Lancashire, Greenock and Bristol, met in his room in Mincing Lane many times during each year, and did hard work in pushing forward the abolition of the sugar bounties. Duncan was full of zeal, and always ready with sound advice and willing service. The pages of "*The Sugar Cane*" in those days gave us frequent reproductions of official letters signed by James Duncan, in which we could read from month to month the various phases of the struggle. The correspondence with the Foreign Office showed that the Government was ready enough to press the matter forward, and that success would have crowned our efforts twenty—if not thirty—years ago, if only the revolver had been loaded.

In that case he might have left Benmore behind him for the benefit of his townsmen. But, alas, it was not to be.

George Martineau.

SIMPLE METHODS OF CHEMICAL CONTROL.

By T. H. P. Heriot, F.C.S.

(*Continued from page 519.*)

VI.

The Optical Test.

Having shown how the total solid matters dissolved in cane and beet juices can be measured by their influence on the density of these liquids, we have now to explain how the more valuable constituent, the crystallizable sugar, may be quantitatively distinguished from the impurities which accompany it. This is essentially a problem of analysis which can be solved in various ways, but the simplicity of the manipulations required in the "optical test" renders the polariscope available to the practical sugar maker, be he a chemist or not.

The Brix Saccharometer is but an approximate guide, and may be compared to the mariner's compass. For finding the exact position, the polariscope has the same importance in the factory as has the sextant on board ship.

The polariscope further resembles the sextant in being a somewhat complicated instrument, although easily manipulated after a little practice. Consequently, the reader who desires to know how cane juice is analysed will not rest satisfied with being told to place his eye at one end of an instrument, and to turn a screw until he obtains a certain optical effect. He would naturally want to know something about the instrument itself, and concerning the why and wherefore of the instructions given him. Believing that such knowledge may prove of interest to many readers, we propose to devote the present chapter to theoretical questions, commencing with :—

The nature of light.—A theory is a provisional explanation of observed facts, and its practical value consists in providing a basis for classifying facts, and thus simplifying the processes of thought. Incidentally, a theory calls forth a host of new experiments and observations in order to test its validity. New facts are thus gained which either support the existing theory or lay the foundations of a more comprehensive one; this, in its turn, serving as a stepping stone towards the acquisition of further facts.

Attempts to explain how the eye becomes affected by distant objects have led to several theories regarding the nature of light itself. The ancients imagined that vision was due to particles escaping from the eye and passing in straight lines towards the object seen. This idea was superseded, or rather, modified, by supposing the particles to be emitted by the source of light, the eye being a passive receiver. This

view was supported by the weighty authority of Sir Isaac Newton, who conceived a luminous object as a sender of light, and the eye as a receiver, the transaction between the sender ond receiver being of the same nature as a ball thrown and caught. This theory explained many of the facts then known, but finally received its death-blow at the hands of :—

The wave theory of light.—Since Newton's time we have become familiar with greatly improved methods of communication between distant persons. Instead of sending a material object (a letter) through the intervening space, we now frequently resort to the telephone and telegraph. Here, also, we find a sender and a receiver of the message, but that which is sent and received is no longer a material object, but an electrical disturbance communicated to a wire stretched between the two parties. Although the exact nature of an electrical disturbance is still unknown, we have abundant evidence of the transference of mechanical disturbances which will help us to understand the wave theory of light.

A stone thrown into a pond momentarily depresses a portion of the liquid surface. In returning to its normal level, the depressed liquid acquires sufficient momentum to carry it a certain distance above that level, so that an up and down motion continues for some time. Although only a certain small area of the water was struck by the falling stone, the disturbance is gradually communicated to the most distant parts of the pond in the form of a rippling circle. This first ripple is closely followed by numerous others, each of which is caused by the alternating (or vibratory) motion of the water at the point struck by the stone. A floating object on the surface of the pond merely rises and falls above and below a fixed point, thus indicating the motion of the water particles. Hence we learn that an up and down motion can be transmitted horizontally.

Passing from this simple case of transmission of motion along a surface, we must now briefly refer to another. A distant bell affects a certain part of the ear : its action must therefore be direct or indirect. Direct action at a distance being inconceivable, we are driven to the only alternative, namely, that there is something between the bell and the ear which acts as a carrier or transmitter of vibrations. Experiment has proved this supposition to be correct. An electric bell and battery were placed under the receiver of an air-pump, and, in proportion as the air was removed from around the vibrating bell, the audible effect became less and finally ceased. The hammer continued to strike the bell as before, but the vibrations of the latter were isolated from the experimenter's ear by removing tne transmitting agent. By the careful study of the vibratory motions of sounding bodies; the structure of the hearing organ; and the physical properties of the atmosphere and of other transmitting media, the wave-theory of sound is now established beyond all possibility of disproof. The

nature of sound-waves does not here concern us but it is important to note that they travel in every conceivable direction from the centre of disturbance, and, in this respect they exactly resemble waves of light.

When distant objects affect the eye, instead of the ear, a similar mechanical explanation is naturally sought for. Now there are very good reasons for believing that both light and heat are due to vibratory motion of the particles composing the luminous and the heated body, although the infinitesimal dimensions of such vibrations would require a transmitting medium possessing very remarkable properties. Rather than abandon a theory, for which no better could be substituted, scientists had to resort to an imaginary medium, permeating all space and all forms of matter, and thus eluding human effort to isolate and examine it; this supposed medium is termed the "luminiferous ether."

The track of a sunbeam through dusty air proves that light travels in straight lines. Hence, we may greatly simplify further enquiry by noting only what takes place along an imaginary straight line connecting a luminous point with a distant observer's eye.

Returning to our former illustration of the telegraph wire, imagine a large central office, with wires radiating in straight lines to every point of the compass. Increase the number of wires indefinitely until the intervening space between the central and distant offices becomes completely filled with wires. Regarded collectively, these wires would represent a vast mass of metal, and, in order to explain how such a metallic mass acts as a transmitting media, we might proceed by showing what takes place along a single wire.

Further, if the central office merely sends out messages to the distant offices, whereas the latter communicate with each other over local wires, the above analogy will be complete. For the central office substitute a source of light; for the receiving offices—objects illuminated by that light; for the intervening metallic media—the luminiferous ether; for the single wires—rays of direct light; and for the single local wires—rays of reflected light. As a telegraphic message can be transmitted by a wire hundreds of miles in length with the same facility as when the wire is but a few inches long, so, in the case of light, distance is quite immaterial from the point of view of transmission, however the intensity of the light may be diminished. This being obvious, our enquiry is reduced to the question—What takes place along any short length of a ray of light?

Let a few particles of ether, composing such a ray, be represented by the dots at (*a*) in *Fig. 15*, so that their relative motions may be graphically traced.

Theory then assumes that these particles are held in their relative positions by the mass of surrounding ether-particles (not shown). From this state of rest (*a*) each particle is free to move slightly out of line, but not in the direction of the line.

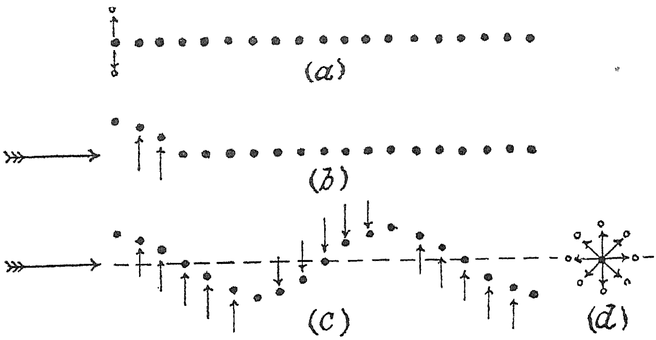

FIG. 15.

If, then, a source of light consists of particles of matter in a state of vibration, we have now to show how these vibrations may be transmitted indefinitely along a line of ether particles. For this purpose let us suppose the left-hand particle in (*a*) to be in direct contact with a vibrating particle of incandescent solid matter. Under these circumstances theory asserts that this particle will be thrown out of line with the others. But this motion, being checked by the surrounding mass of ether particles, is soon reversed, so that the particle now moves to an equal distance in the opposite direction, the two extreme positions being indicated by the outline dots at (*a*).

Being, however, in direct contact with a second particle of ether lying in the same straight line, the motions of the first will be communicated to the second, from the latter to a third, and so on indefinitely. Such transmission of motion from particle to particle cannot be instantaneous all along the line, and, in this respect, the theory agrees with the facts, for "light" takes time to travel, and its actual velocity has been measured.

Since, then, the vibratory motion is transmitted gradually, it follows that each successive particle of ether commences to vibrate in turn, and this is roughly represented at (*b*), *Fig. 15.* The horizontal arrow indicates the direction in which light is being transmitted, and this transference of motion is represented as having proceeded as far as the third dot, the others remaining at rest. The direction in which each dot is moving is shown by the perpendicular arrows. As in (*a*), the intermediate dots, which would fill up the gaps, are omitted.

When the vibratory motion has been caught up by all the ether particles, we have the effect shown at (*c*), where all the dots are in motion except those at the extreme positions above and below the normal (dotted) line, these being at the turning point. The dots situated on the normal line are not at rest, but exactly half way between their extreme positions.

Here we have a definite appearance of waves, and if the dotted line be taken to represent the undisturbed surface of water, the positions and relative motions of the dots will fairly represent the motions of water particles when thrown into ripples or waves.

But, in the figure, the dots can only be represented as vibrating in a *single plane* (*i.e.* that of the paper), and such simple motion is only true of a ray of *polarized* light, as will shortly appear. In a ray of *ordinary* light, the vibrations lie in every conceivable direction about a fixed central point, so that, viewed from either end of the line, the dots would move in the directions shown at (*d*), and in all intermediate directions. Dispensing with the dots, a line of undisturbed ether particles may be more accurately represented by a continuous straight line built up of an innumerable number of points. When all these points are in vibration the effect would be to increase the thickness of the line.

As we cannot proceed until this idea is clearly grasped, let us make use of a large model, and regard the wick of a candle as representing a line of ether particles at rest.

A thin slice of the candle contains a fragment of wick embedded in in the centre of a disc of wax. Now if this fragment could vibrate like a particle of ether, its vibrations would lie within the space occupied by the disc of wax, and any two opposite points on the circumference of the disc of wax would represent the extreme positions between which the fragment of wick is capable of vibrating.

As the whole candle may be regarded as built up of an infinite number of such slices, it will be seen that the wax represents vibrations of the central-lying wick.

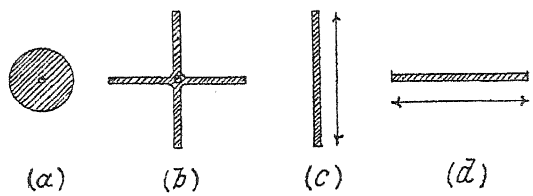

Fig. 16.

The section of the candle, shown at (*a*), *Fig. 16*, is perfectly symmetrical, and, of course, the same holds good for any section at right angles to the length of the candle. Our model thus illustrates an important property of a ray of ordinary light.

On passing such a ray through certain crystalline minerals this symmetry is lost, and the ray is said to be polarized.

To illustrate this with our model we may suppose the candle to be passed from end to end through a machine, which presses the wax into two narrow channels at right angles to each other. Any section of the moulded candle would then have the appearance shown at (*b*), *Fig. 16*. As the wax represents vibrations only, we may express this

result in terms of ether by saying that the vibrations have been confined to two planes, perpendicular to each other, and shown separately at (*c*) and (*d*). Moreover, the wax being equally distributed in (*b*), the number of ether vibrations in the direction (*c*) is exactly equal to the number in the direction (*d*). In fact the original ray of light has been split up into two polarized rays of equal intensity. These polarized rays do not pass through the polarizing crystal in the same direction; hence they can be separated by means of suitable optical arrangements.

This may also be roughly reproduced if the moulding machine be fitted with two parallel cutting edges, set perpendicularly. The original section (*a*) of the candle would first be moulded into the form (*b*), the two horizontal limbs then cut away, and the remainder emerge as a ribbon of wax, whose section is represented at (*c*). If the cutting edges be set horizontally, the ribbon of wax will emerge from the machine in the position (*d*). In either case the ribbon represents a ray of polarized light; that is to say, a ray in which the vibrations lie in *a single plane*.

Polarized light cannot be recognised as such by the eye until examined through a second crystal similar to that producing the polarized ray; the first crystal is then called the *polarizer* and the second the *analyzer*. It is then found that the polarized ray is only freely transmitted by the second crystal when certain axes of both crystals lie in the same plane. In all other positions, the second or analyzing crystal is less transparent to the polarized ray, and appears to become quite opaque when the said crystalline axes are set at right angles to each other. This variable transparency of the second crystal appears to be due to internal structure, which may be mentally represented as fibrous, like wood. On this assumption, the observed facts might be expressed by saying that when the ether vibrates *with the grain* of the polarizer such vibrations will be transmitted in a similar direction through the analyzer, but not *against the grain* of the latter.

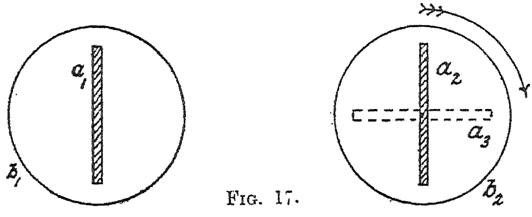

FIG. 17.

Appealing once more to our model, let one end of the moulding-machine terminate in a metal plate (*b*), *Fig. 17* having two parallel cutting edges forming a narrow slot (*a*), and let two such machines be arranged opposite to each other.* Now if the two slots (a_1) (a_2)

* In the figure the plates are represented *side by side* for the sake of clearness.

are both perpendicular, the ribbon of wax emerging from (a_1) will freely enter (a_2). If, however, the plate (b_2) be turned on its centre in the direction of the arrow until the slot (a_2) is in the position (a_3) the tape of wax will no longer pass from one slot to the other unless it be twisted.

Substituting polarizing and analyzing crystals for the plates (b_1) (b_2), the reader should now have some idea of the peculiar nature of a polarized ray according to the wave-theory of light.

Now, certain crystals and a few liquids possess the remarkable property of twisting a ray of polarized light so as to change the plane of vibration of the ether-particles. If, for example, a polarized ray, composed of vibrations in the perpendicular plane, (*c*) *Fig. 16*, be passed through a solution of sugar, the plane of vibration is twisted round towards the horizontal plane (*d*). In fact, the effect would be similar to that of twisting the ribbon of wax emerging from the slot, (a_1) *Fig. 17*, until the free end could be inserted in the slot (a_3).

The angle through which the plane of vibration is thus turned depends upon two factors—the strength of the sugar solution, and the depth of liquid through which the polarized ray is caused to pass. So long as these two factors remain unchanged, the ray is always twisted through precisely the same angle. By maintaining the depth of liquid constant, the polarized ray is twisted in proportion as the solution is rich in sugar, and this constitutes the basis of quantitative measurement adopted in the polariscope.

This instrument may be briefly described as a horizontal tubular body containing a polarizing crystal at one end and an analyzing crystal at the other. Between these there is space for inserting a tube filled with the solution to be tested, and closed at its extremities by glass plates so that light may pass through the tube from end to end. The length of the tube thus regulates the depth (or thickness) of liquid to be optically examined. A lamp-flame being placed opposite that end of the instrument containing the polarizer, a beam of polarized light is passed through the tube containing the liquid, then through the analyzer, and finally reaches the observer's eye. Every polariscope is also fitted with an arrangement for measuring the angle through which the plane of the polarized ray is turned, or twisted, during its passage through the sugar solution.

The simplest arrangement is that in which the analyzing crystal can be turned on its axis, like the plate (b_2) in *Fig. 17*. For this purpose the crystal is mounted in a sleeve, which can be rotated by means of a rack and pinion. When this is done, a pointer carried by an arm describes an arc opposite a fixed circular plate which is finely graduated at its circumference. When the pointer is opposite the zero of the scale, the relative positions of the polarizer and analyzer are identical, and the beam of polarized light will pass directly through the analyzer. But on inserting the "observation tube" filled with

a solution of sugar, the analyzer now cuts off a portion of the light. On turning the analyzer round, a point is soon reached when the twisted ray of polarized light is again freely transmitted. The position of the pointer on the graduated arc then shows the angle through which the analyzer has been turned, and, consequently, the angle through which the polarized ray was twisted during its passage through the sugar solution.

A more general arrangement, however, is to fix both the polarizer and analyzer, so that the latter freely transmits the ray received directly from the former. The optical activity of the sugar solution is then neutralised by causing the twisted ray to pass through another substance capable of turning the plane of the polarized ray in a reverse direction. Hence, one might say that the ray is twisted in one direction by the sugar solution and then twisted in the opposite direction by the compensator, so that on reaching the analyzer the vibrations are in precisely the same plane as when the ray left the polarizer. Such a compensating material is a certain variety of quartz, and in this type of polariscope a polished wedge of quartz is moved across the path of the polarized ray, between the sugar solution and the analyzer, until a sufficient thickness of quartz is interposed to exactly compensate for the optical effect of the solution.

The quartz-wedge is mounted in a metal frame, which slides in suitable guides and is put in motion by means of a rack and pinion. The top of this frame carries a scale graduated in percentages of sugar from 0 to 100, so that every motion of the quartz-wedge brings different parts of the scale opposite a fixed point; the relative positions of the latter indicating the percentage of sugar in the liquid examined. The polariscope specified in the list of apparatus is of this type, and certain other features of this instrument will be dealt with in the next chapter.

(To be continued.)

THE INFLUENCE OF SODA SALTS IN THE SOIL ON THE CONSTITUTION OF SUGAR CANE.

By H. C. Prinsen Geerligs.

It is a remarkable fact that sugar cane grown on a salt soil contains an exceedingly small amount of soda salts, even in those cases where these canes are rich in chlorine. Cane can thrive very well on land which does not contain any chlorine salts at all, which proves that it does not need those salts for its development. If, however, cane is planted on land which is salty owing to its vicinity to the sea shore, or from any other reason, the analysis of the juice of such cane shows a large amount of chlorine; but then this constituent is not combined with soda but with potash. The aim of the investigations, which are

set forth in this article, was to examine in what way the chlorine, which was first combined with soda in the soil, was absorbed by the plant in combination with potash.

First of all, I must mention a series of analyses of cane molasses, which show that a high potash content is equally met with in combination with a high, and with a low, figure for the chlorine, whilst the figure for the soda, though in some cases higher than usual, remains far behind that for the potash. Since in the last few years nothing has been added to the juice during the course of manufacture that is apt to change the mutual proportion of the chlorine, soda and potash, the analysis of the molasses may be substituted for that of the original juices for the investigations under review here; this gives one the advantage of greater accuracy in the figures because the constituents to be analysed are in a more concentrated state in the molasses than in the juice, and thus more easily determined. Further, I want to state here, that the figures for both potash and soda are found by direct analysis and not calculated by an indirect method.

The potash was estimated by precipitating the solution of the ash of molasses by baryta water, and after filtration, by carbonates of ammonia. The filtrate was evaporated in a platinum dish, acidulated with hydrochloric acid, evaporated again, and the residuum slightly ignited to drive off the ammonia salts. The potash was precipitated with chloride of platinum and alcohol in the proper way, whilst the soda was determined by precipitating the platinum from the filtrate by means of formiate of ammonia and weighing the evaporated and ignited residue as sodium chloride.

Besides Java molasses, I also analysed a number of cane molasses from other countries, among which I particularly chose such as were originally from places close to the sea. Their analysis confirmed my experience obtained with the Java molasses, viz., that a high chlorine content always coincides with a high amount of potash, while the amount of soda is always insignificant, although the chlorine had originally occurred in combination with that element.

I give below a series of 20 analyses of exhausted molasses, made in 1891*; in examining the 58 samples, mentioned in *Sugar Cane*, 1901, page 521, the soda was not estimated in a direct way and can therefore not be taken in account; but this year I finished the total analysis of a further series of exhausted molasses, which will be published later on, but from which I quote now the figures for chlorine, potash, and soda, in the table underneath.

No.	Potash.	Soda.	Chlorine.	No.	Potash.	Soda.	Chlorine.
1	1·20	0·03	0·03	5	2·21	0·26	0·34
2	2·85	0·13	0·14	6	1·97	0·07	0·08
3	1·92	0·31	0·48	7	1·62	0·10	1·04
4	2·80	0·11	0·48	8	1·92	0·10	0·59

* *Sugar Cane*, 1893, p. 598.

No.	Potash.	Soda.	Chlorine.
9	2·16	0·11	0·46
10	2·83	0·23	0·51
11	2·52	0·06	0·27
12	2·04	0·10	0·59
13	2·83	0·11	0·78
14	2·28	0·26	0·75
15	2·27	0·16	1·28
16	2·20	0·14	1·23
17	2·64	0·11	0·54
18	1·65	0·03	not det'm'd
19	2·64	0·08	not det'm'd
20	1·79	0·12	not det'm'd
21	3·83	0·05	0·31
22	4·34	0·00	0·64
23	2·48	0·10	0·61
24	3·93	0·20	0·34
25	4·25	0·57	0·38
26	3·76	0·13	0·68
27	3·76	0·14	0·52
28	4·07	0·09	0·71
29	4·20	0·06	0·34
30	2·73	0·00	0·38
31	2·62	0·07	0·38
32	4·68	0·15	0·72
33	3·20	0·08	0·17
34	3·89	0·11	0·54
35	5·07	0·05	0·68
36	3·00	0·07	0·30
37	3·62	0·10	0·38
38	3·32	0·07	0·37
39	3·73	0·14	0·30
40	3·76	0·10	0·65
41	3·87	0·00	0·51
42	5·11	0·00	0·37
43	3·34	0·00	0·17
44	4·67	0·51	0·89
45	5·48	0·12	0·99
46	3·76	0·44	0·45
47	3·90	0·08	0·40
48	3·31	0·14	0·58
49	3·64	0·14	0·55
50	3·88	0·11	0·41
51	2·98	0 06	0·35
52	3·31	0·06	0·25
53	4·02	0·38	1·25
54	3·50	0·00	0·59
55	3·44	0·25	0·23
56	3·96	0·00	0·52
57	3·44	0·15	0·68
58	3·54	0·00	0·27
59	4·56	0·00	0·58
60	4·32	0·13	0·38
61	3·17	0·09	0·20
62	3·96	0·00	0·21
63	3·99	0·17	0·37
64	2·32	0·00	0·21
65	3·40	0·17	0·31
66	3·93	0·23	0·31
67	3·24	0·06	0·24
68	4·44	0·14	0·30
69	3·62	0·00	0·28
70	3·48	0·16	0·45
71	4·88	0·00	0·71
72	3·10	0·04	0·21
73	4·17	0·08	0·61
74	4·06	0·01	0·44
75	3·61	0·02	0·42
76	3·36	0·14	0·45
77	4·91	0·25	0·93
78	4·51	0·10	0·71
79	4·27	0·00	0·74
80	4·01	0·04	0·64
81	3·38	0·13	0·16
82	3·27	0·15	0·16
83	4·98	0·11	0·82
84	6·47	0·00	2·52
85	3·01	0·00	0·30
86	4·07	0·06	0·59
87	6·03	0·06	1·54
88	4·03	0·02	0·85
89	3·30	0·08	0·44
90	5·04	0·10	0·51
91	4·45	0·14	0·65
92	3·08	0·10	0·20
93	3·13	0·06	0·28
94	4·88	0·06	0·37
95	5·35	0·06	0·95
96	2·36	0·00	0·34
97	3·86	0·08	0·46

These were all exhausted molasses from some 80 different factories, all of them representing the average constitution of the molasses produced during the whole grinding season. The analyses mentioned in the next table are from molasses produced by canes from specially salt land, which accounts for the rather high chlorine figures of all those samples.

CONSTITUTION OF MOLASSES FROM SUGAR CANE GROWN ON SALT LAND.

	Caledonian Estate, Prov Wellesley, 1895.	Caledonian Estate, Prov. Wellesley, 1899.	Kaliwoenggoe, Kendal.	Plantation Port Mourant, Nickerie.	Petjangaän, Koedoes.	Hawaii. A.	Hawaii. B.	Demerara.	Byrom Estate, Prov. Wellesley, 1904.	Mauritius.
Ash	6·22	7·82	9·11	11·04	9·28	12·31	12·78	7·58	6·80	8·00
Soluble Ash ..	4·36	5·00	6·11	8·04	6·48	7·85	7·83	6·19	4·70	5·10
Insoluble Ash.	1·86	2·82	3·0	3·0	2·80	4·46	4·95	1·39	2·10	2·90
Silica..	0·55	0·28	0·08	0·25	0·08	0·34	0·44	0·11	0·17	0·15
Iron oxide, &c.	0·73	0·66	0·28	0·75	0·65	0·31	0·52	0·08	0·13	0·15
Lime	0·25	0·87	1·12	0·56	1·14	1·50	1·51	0·44	0·26	1·08
Magnesia ..	0·07	0·25	—	0·43	0·19	0·42	0·60	0·32	0·18	0·88
Sulphuric Acid	0·83	0·87	0·85	1·45	0·30	1·06	1·08	0·98	0·50	1·23
Chlorine	1·02	1·35	1·10	1·96	1·08	2·48	2·48	1·47	1·32	1·30
Potash	2·99	2·72	3·74	5·01	3·88	4·59	4·61	3·88	2·84	2·60
Soda	0·16	0·19	0·23	0·20	0·19	0·31	0·35	0·26	0·15	0·32

The analyses of cane juice from various experimental plots with fertilizers of every kind, mentioned by Kramers,* equally show a well-marked preponderance of the potash salts above the soda salts in the juice. Kramers says:—

"The quantity of soda is very variable, and even sinks so low as to being totally absent. It is, besides, a well-known fact that soda is superfluous for the nutrition of sugar cane, and from a practical point of view one may even say the less salt in the juice the better

* Archief voor de Java Suikerindustrie. Bylage 1900, 184.

for the sugar manufacturer. What however strikes one most in the figures for the ash is that manuring with Chile saltpetre does not increase the ratio of soda in the ash; it is true that this can only be stated here as regards the particular quantity of that fertilizer used in the experiments, viz., that of 200 pounds per acre, and cannot show what will happen with an increased application of the saltpetre. But anyhow experiments with 400 and 800 pounds of saltpetre per acre did not yield cane with a higher content of ash, so we may conclude that the amount of soda in the juice did not increase either."

Pellet quotes,* in his noteworthy review on the analysis of molasses, the constitution of a number of cane sugar molasses and syrups, and their ash from Guadeloupe, Spain, Mauritius, Java, &c. In all those samples the amount of soda is vastly inferior to that of the potash, which leads him to the following conclusion:—

"We know that in general sugar cane contains but little soda, averaging about 5% of the figure for the potash. Yet sometimes evident differences may be observed, brought about by the nature of the cane and of the soil where it has been grown. If we take into consideration, for instance, the average analysis of the ash of a large Egyptian sugar mill (grinding 80,000 metric tons of cane yearly), then we find from two to three parts of soda per 42-45 parts of potash in the form of chloride, sulphate, or carbonate. When, however, analysing molasses from single plots of cane from the same country, sometimes much soda and sometimes very little may be found. The average proportion is five; five parts of soda in 100 parts of potash, with a minimum of 0·19 and a maximum of 16·3."

From all these analyses and data it has become evident that sugar cane has a predilection for potash, while assimilating as little soda as possible; to such an extent that where a great abundance of sodium chloride exists in the soil, the cane only takes the chlorine, whereupon it is no longer combined with the soda but with potash. In this case this potash must have been present somewhere, and hence there is no doubt that that element had been present in the soil as a silicate, and has been transformed into potassium chloride, and sodium silicate, by mutual interchange with the elements of the sodium chloride.

At my request, one of my assistants, Mr. van der Jagt, planted cane in large culture vessels in soil from a cane field; he added at intervals sodium chloride to some of the vessels, calcium chloride or magnesium chloride to others, leaving the remainder free from salts. After a year he cut the canes, crushed them in a small cane mill, then collected and analysed the juice. The particulars of this experiment are combined in the three following tables:—

* Bulletin de l'Association des Chimistes 15, 930.

TABLE SHOWING THE QUANTITY OF SALTS ADDED AND OF THE WEIGHT OF CANE OBTAINED.

Number of the Vessel.	Nature and Quantity of the Salt.	Weight of the Cane in Kilogrammes.
I.	128·7 grams NaCl	7·895
II.	250 ,, $MgCl_2$	6·969
III.	128·7 ,, NaCl	6·335
IV.	500 ,, $MgCl_2$	7·715
V.	257·4 ,, NaCl	8·482
VI.	386 ,, NaCl	5·915
VII.	No addition	7·445
VIII.	211 grams $CaCl_2$	6·815
IX.	315 ,, $CaCl_2$	6·915
X.	No addition	8·365
XI.	No addition	9·880
XII.	257·4 grams CaCl	9·235

In all the cases where soluble chlorides are added to the soil, we perceive an increase in the potash contents of the cane-juice, which proves that sodium chloride, as well as magnesium chloride and calcium chloride, has a dissolving influence on the fixed constituents of the soil. An addition of sodium chloride slightly raised the soda figure in the juice, and that actually in proportion to the quantity of salt added, but in every instance it remained far below the figure for the potash, and amounted in the most extreme case to no more than 18% of the potash content, though doubtless the total quantity of available and even of total soda salt has several times exceeded that of the total amount of potash, and especially that of the available part of that constituent. With the calcium and magnesium chloride vessels the same phenomenon was observed; there, too, the percentage of lime and magnesia salts in the juice increased, but remained inferior to the potash, although the latter occurred in the soil in a fixed state, whilst the salts of the two other elements were free.

The fact that the chlorides dissolved potash from the soil and rendered it available for the cane can be easily explained. In the soil we have, even if the percentage be rather small, a considerable total quantity of potash; sometimes in land close to the sea or to salt wells, this soil is from time to time moistened by salt water, containing an amount of sodium chloride, which, in respect to the quantity of water is rather high, but is relatively small when compared with the total quantity of potash already mentioned. Now there is a great chance that, according to the law of mass action, the dissolved and the fixed materials will act upon one another with the result that a great deal of the sodium chloride in chemical reaction with the potassium silicate is transformed into sodium silicate and potassium chloride, which are readily absorbed by the cane. This same reaction takes place where the chlorides of calcium and magnesium combine with the potassium silicate or carbonate.

TABLE SHOWING THE NUMBER OF MILLIGRAMS OF EACH CONSTITUENT ON 100 GRAMS OF JUICE.

Number.	Grammes NaCl.	Grammes $MgCl_2$.	Grammes $CaCl_2$.	Insoluble Ash.	Soluble Ash.	Total Ash.	SiO_2.	CO_2.	P_2O_5.	$F_2O_3 + Al_2O_3$.	CaO.	MgO.	Cl_2.	SO_3.	K_2O.	Na_2O.
II.	..	250	..	147·9	296·5	444·4	38 0	23·2	59·7	15·4	21·9	24·3	97·0	8·9	176·2	1·7
IV.	..	500	..	147·0	408·6	555·6	32·2	20·8	51·3	11·5	22·9	31·8	161·7	8·8	251·0	niets
X.	..	.	..	80·5	178·0	258·5	27·2	32·5	48·0	7·5	14·0	9·6	8·4	5·6	103·2	4·4
I.	128·7	..	..	75·1	342·5	417·6	20·2	25·1	47·5	2·9	45·6	13·2	85·9	19·2	191·8	15·6
III.	128·7	..	..	100·7	410·1	510·8	27·6	27·8	47·4	9·8	19·3	14·8	114 0	23·6	243·8	8·4
V.	257·4	..	..	88·5	500·2	588·7	22·8	11·8	39·8	5·9	18·4	15·8	182·1	20·9	284·2	28·0
VI.	386·0	..	..	148·2	626·6	774·8	42·8	24·6	52·8	13·6	27·0	22·0	269·6	27·3	299·7	56·1
XII.	257·4	..	..	113·0	.	..	.	..	..	9·5	22·4	16·2	*	.	..	..
XI.	..	..	..	72·9	279·5	352·4	35·0	43·4	28·9	7·4	14·5	7·0	28·1	18·1	173·1	3·2
VIII.	..	..	211·0	106·5	499·4	605·9	26·4	16·2	31·9	5·8	31·1	12·5	198·9	21·1	305·9	1·0
IX.	..	..	315·0	102·0	633·5	735·5	28·6	16·8	16·4	8·6	33·6	13·5	272·1	17·0	384·3	5·9
VII.	..	..	..	68·0	277·7	345·7	28·4	26·8	59·4	3·7	12·3	8·8	10·5	46·0	147·1	5·1

* The soluble part of the ash of No. XII. has gone low during analysis.

TABLE SHOWING THE TOTAL AMOUNT OF MINERAL MATTER (IN MILLIGRAMS) IN THE JUICE OF THE CANE STALKS.

Number.	Grammes NaCl.	Grammes $MgCl_2$.	Grammes $CaCl_2$.	Insoluble Ash.	Soluble Ash.	Total Ash.	SiO_2.	CO_2.	P_2O_5.	$Fe_2O_3 + Al_2O_3$.	CaO.	MgO.	Cl_2.	SO_3.	K_2O.	Na_2O.
II.	..	250	..	8655	17358	26013	2224	1356	3493	902	1282	1421	5677	522	10315	100
IV.	..	500	..	9527	26478	36005	2087	1349	3322	745	1484	2063	10480	569	16267	niets
X.	.	..	..	5654	12509	18163	1911	2282	3369	527	984	675	591	396	7252	309
I.	128·7	..	..	4979	22716	27695	1340	1665	3146	192	1035	875	5696	1275	12722	1033
III.	128·7	..	..	5358	21825	27183	1469	1481	2524	522	1027	786	6066	1257	12970	448
V.	257·4	..	..	6304	35631	41935	1624	842	2835	420	1311	1126	12973	1487	20247	1994
VI.	386·0	..	..	7367	31123	38490	2127	1226	2624	676	1341	1093	13393	1351	14891	2786
XII.	257·4	..	..	8759	..	..	..	..	..	737	1738	1254	*	..	..	..
XI.	..		..	6045	23204	29249	2904	3608	2391	614	1203	581	2332	1504	14370	268
VIII.	..	..	211·0	6095	28591	34686	1511	927	1825	332	1780	715	11386	1210	17511	55
IX.	..	..	315·0	5968	37062	43030	1673	986	955	503	1966	789	15921	996	22485	344
VII.	.	..	..	4262	17394	21656	1778	1684	3721	232	772	549	657	2880	9213	318

* The soluble part of the ash of No. XII. has gone low during analysis.

It is a well-known fact that interchanges of constituents between bodies with four different ions go much farther than when only three ions can participate in the reaction. In order to show this, I put gypsum in bottles, which already contained salt solutions of concentrations proportional to the equivalent weight of the salts. Besides that, one of the bottles was filled with pure water and gypsum only. The solutions were as follows :—

(*a*) Pure water.
(*b*) Solution of 2·0% sodium chloride.
(*c*) Solution of 2·55% potassium chloride.
(*d*) Solution of 5·51% sodium sulphate with 10 mol. H_2O.
(*e*) Solution of 3·0% potassium sulphate.
(*f*) Solution of 2·0% anhydrous calcium chloride.
(*g*) Solution of 2·8% anhydrous calcium nitrate.
(*h*) Solution of 2·9% sodium nitrate.
(*i*) Solution of 3·5% potassium nitrate.

The gypsum and the salt solution were shaken a few days and afterwards the amount of sulphate or lime, or both, were determined in the liquid filtered off from the superfluous gypsum. The percentage of gypsum dissolved in the various liquids was as follows :—

(*a*)	0·208	(*d*)	0·150	(*g*)	0·135
(*b*)	0·454	(*e*)	0·144	(*h*) ...	0·460
(*c*)	0·452	(*f*)	0·106	(*i*)	0·461

These experiments prove that as soon as the mixture contains (excepting calcium and sulphuric acid) still sodium or potassium and chlorine or nitric acid, so as to yield four ions, a reaction takes place, causing the formation of sodium or potassium sulphate and chloride or nitrate of calcium. In the case where only sulphuric acid is present as a negative ion or only calcium as a positive one, so that only three ions exist in the solution, then no interchange of constituents can take place but at the utmost a formation of double salts only, and then sometimes even less calcium or sulphuric acid is dissolved than in the case of pure water. Although the expression is, chemically speaking, incorrect, we may say from a practical point of view, that the alkali salts of hydrochloric and nitric acid have dissolved a part of the gypsum.

This result may be applied to our case, viz., the mutual reaction of sodium chloride and potassium silicate. Here we have again our four ions and thus every chance of mutual interchanging and, in consequence thereof, a dissolution of fixed soil constituents. The examination of this problem was very easy when sodium chloride and gypsum were studied, and where every element could be determined rapidly with great exactitude, but the problem becomes very difficult for the determination of potash and soda in the soil. Not only is it a difficult separation of traces of potash from large quantities of soda, and of small amounts of soda from a great surplus of potash, which

makes the work intricate; but, in addition, the well-known absorbing property of soil for potash salts is a drawback for the rapid and accurate determination of the quantity of potash dissolved.

I fancied that perhaps the determination of the electrical conductivity of the soil extract could be of use here. Such a determination is based on the conductivity or on the resistance which the solution of an electrolyte offers to the electric current; it may be determined by means of the Wheatstone bridge and from the given readings the concentration and even, in special cases, the constitution of a solution may be derived.

Suppose that we determine the electrical conductivity of a deci-normal solution of sodium chloride at a given temperature, and also that of a deci-normal solution of potassium silicate at the same temperature. Now we determine the conductivity of a mixture of equal parts of a 1/5 normal solution of sodium chloride and of potassium silicate. In this mixture the four ions will interchange, forming all the four combinations possible in the maximum proportions dictated by the laws of chemical equilibrium, and if perchance the conductivity of the new combination of molecules did deviate clearly and distinctly from the calculated sum of the two original conductivities of the solutions of pure salts, then the determination of the electrical conductivity would be a valuable method for following day by day the gradual dissolution of potassium silicate in the soil and its transformation into potassium chloride, provided that the sodium chloride did not exert its dissolving influence on any soil constituents other than potassium silicate.

I requested Mr. van der Jagt to investigate this question, whereupon he produced these figures:—

Temperature, 28° C.	
Electrical conductivity of deci-normal potassium silicate	0·012240
Electrical conductivity of deci-normal sodium chloride	0·011410
Calculated sum	0·023650
Determined electrical conductivity of a mixture of equal parts of 1/5 normal sodium chloride and 1/5 normal potassium silicate	0·023095

Temperature 28° C.	
Electrical conductivity of 1/5 normal potassium silicate	0·024615
Electrical conductivity of 1/5 normal sodium chloride	0·021400
Calculated sum	0·046015
Determined electrical conductivity of a mixture of equal volumes of 1/2·5 normal potassium silicate and 1/2·5 normal sodium chloride ..	0·040875

The difference between the calculated sum, *i.e.*, the conductivity of the two constituents before their reaction on one another, and the determined conductivity of the mixture at the time that the maximum reaction has taken place, is so trifling that it renders this method unfit for detecting and determining the gradual dissolution of small quantities of the silicates, and therefore I had to have recourse to the much more intricate chemical methods. These, besides involving a greater length of time, have the disadvantage of using up too much of the material in one trial; whereas the latter under the physical method remains intact and may be examined again daily.

Following my instructions Mr. van der Jagt irrigated soil in flower pots with water, which for one series remained without addition, and for the other series were respectively treated with 0·50% sodium chloride, 1% sodium chloride, and 0·50% calcium chloride, the solutions allowed to drain off slowly and poured back. This process was repeated several times during a month, after which period the water drained off was analysed with this result:—

	No addition. Mgr.	0·5% NaCl. Mgr.	1% NaCl. Mgr.	0·50% $CaCl_2$. Mgr.
Soda	Not specified.	188	322	16
Potash		19	29	17
Lime		63	97	189
Magnesia		23	30	31
Chlorine		312	601	312
Silica		8	12	9
Total dissolved	22	613	1091	574
Abstr. oxygen equivalent to Cl.		70	136	70
	22	543	955	504

All this in a volume of 100 c.cm. of the drain water. It is to be noted that sulphates, phosphates, and iron salts were absent from the solutions.

The experiment was next repeated on a bigger scale. Large culture vessels, fitted at the bottom with a spout and a cock, were filled with soil from a cane field. One of them was irrigated with pure water, a second one with a 1% sodium chloride solution, and a third with a solution of calcium chloride in concentration equivalent to that of the sodium chloride solution, thus containing 0·95% of the anhydrous salt. The solutions were left in contact with the soil for some time, drained off, and poured again over the soil, care being taken to add some water as a correction for the evaporation. After a month the drain waters were analysed, and contained per 100 c.cm. these constituents in milligrammes.

	Water.	Sodium chloride.	Calcium chloride.
Soda	4	331	7
Potash		12	8
Lime	Not Specified.	123	403
Magnesia		35	50
Chlorine		615	624
Silica		8	19
	17	1124	1111
Abtr. O_2 equivalent to Cl_2		138	141
	17	986	970

After these experiments were finished, I received the Report of the Hawaiian Experiment Station for 1902, in which the Director, Mr. Eckart, mentions his experiments on the use of salt water for the irrigation of sugar cane and the dissolving action of sodium chloride on the soil elements and the fertilizers. Among other experiments I quote here one, in which five big tubs, having a sieve bottom, were filled first with a layer of sand in order to promote drainage and next with so much earth from a cane field, that in every case the weight of the dry earth amounted to 158 lbs. They were numbered from 10 to 14; numbers 10, 11, 12 and 14 were manured with ten grammes of nitrogen, five grammes of potash and five grammes of phosphoric acid, while No. 13 remained without any fertilizer. The numbers 10-13 were irrigated with salt water and No. 14 with pure water. Each tub was irrigated with 356 litres of liquid; those which belonged to the salt water series obtained dissolved in that irrigation water 715 grammes of chlorine in the form of sodium chloride. After each irrigation the drain-water was analysed and after 20 irrigations the experiment was stopped. In this experiment the following elements were removed in the drain-water, in grammes:—

	No. 10.	No. 11.	No. 12.	No. 13.	No. 14.
Potash	22·393	22·952	22·860	19·222	5·543
Lime	115·497	120·751	119·360	111·822	16·406
Magnesia	63·912	72·011	63·567	60·995	4·831
Phosphoric acid	0·203	0·183	0·1417	0·166	0·813

In full accordance with my experiments the data recorded here prove that sodium chloride dissolves large quantities of lime, magnesia and potash from the soil, but no phosphoric acid. The lime is dissolved in the highest degree, next the magnesia and finally the potash, and it is only in consequence of the predilection sugar cane has for potash, that the increase of soluble potash salts by the action of sodium chloride becomes so much more evident in the composition of the mineral matter of cane juice, than the increase in the calcium and magnesium salts. Eckart calculates from his experiments that one part of chlorine in the form of sodium chloride extracts 0·332

parts of lime and 0·017 parts of potash from the soil, though I believe that in this matter the degree of withering of the soil fragments, the duration of the reaction, and perhaps some other factors too, will exert their influence. As the arable soil usually has an intricate composition and may cause many an unexpected influence in the analysis of the soluble elements, I tried the action of chlorides of the alkali metals on finely powdered felspars of a certain composition. I choose for this end *orthoclase* as a potash felspar, *albite* as a soda felspar, and *oligoclase* as a mixed soda-lime felspar. These minerals were powdered very finely and put into stoppered bottles, covered with a glass cap to prevent evaporation. Each of the three minerals had distilled water poured over it, next another portion of the *orthoclase* and *oligoclase* series was brought in contact with a 2% sodium chloride solution and finally portions of the *albite* series with a 2% solution of potassium chloride. The six different mixtures were well stoppered and occasionally shaken during three months, after which period the solutions were filtered off and analysed.

The result of the action of the chlorides on the freshly powdered unweathered minerals was, however, well nigh insignificant. The salt solution, which had remained in contact with the potash felspar had only dissolved a few milligrams of potash per 100 c.cm., while about the same amount had been dissolved from that same mineral by pure water. The soda felspar gave off but 32 milligrammes of soda as sodium chloride to the potash solution, and to distilled water the equivalent of 35 milligrammes or the same amount. The potash content of the sodium chloride solution that had been shaken with the powdered *albite* amounted to 11 milligrammes and the distilled water, which had been in contact with that mineral contained 10 milligrammes of that element, thus confirming the experience obtained with the other two minerals, namely, that the action of salt solutions on unweathered minerals is imperceptible. The degree of the weathering of the elements of the soil is therefore an important factor in the study of the action of salt on soil and it will be seen we need not fear that one single inundation of the land with salt water will deprive the soil of its whole potash content.

The dissolving action is not only confined to the chloride of soda but is also proper to, *e.g.*, its sulphate, as is clearly shown by the fact that in Egypt cane is grown on land which contains so much sodium sulphate that it effloresces from the soil; yet the juice of those canes contains much potash and only little soda, just as we have seen with the sodium chloride. The cane does not grow well on such land and the fields want constant irrigation to get rid of the superfluous salts, but this point does not affect our present subject.

The analysis of such an efflorescence, obtained by the courtesy of Mr. H. Naus, yielded these figures :—

	Per cent.
Sodium sulphate	72·05
Sodium chloride	19·60
Calcium sulphate	3·15
Calcium carbonate	1·05
Magnesium sulphate	3·55
Potassium sulphate	0·60
	100·00

Notwithstanding this excess of sodium salts, the cane of such fields contains, according to the special reports of M. Pellet, but little soda and about twenty times as much potash, proving that the soda salts break up the fixed potash combinations in the soil, and next that the cane eagerly assimilates potash and with corresponding reluctance absorbs as little soda as possible.

I wanted to prove this last point by a direct experiment, and so planted cane in a soil which was as exempt from potash as I could secure it. I did not trust the results of water cultures, since I repeatedly observed that in such cultures cane already died amid concentration of some bodies, which it could stand very well in the soil. Soil free from potash was not available in Java, so I ordered quartz-sand from a heath in Holland, which consists of pure quartz, without addition of shells or other foreign bodies.

Cane tops were planted in large culture vessels filled with that sand, and after their sprouting they were manured with a few grammes of guano and, further, repeatedly watered with a 1% salt solution. After a year's time the cane was cut, 460 grammes of the stems was chopped up, incinerated, and the ash analysed with the following result:—

	Grammes.		Grammes.
Soda	1·016	Lime	0·358
Potash	0·199	Magnesia	0·146

	Grammes.
Sulphuric acid	0·680
Phosphoric acid	0·107
Silica	0·915
Chlorine	0·870
	4·589
Abtr. Oxygen equivalent to Cl.	0·196
	4·390

The potash, lime, phosphoric and sulphuric acid were originally from the guano, while the magnesia had been added as a constituent of the crude salt of the Government salt monopoly used in these experiments. This experiment proves that only in the case of an extreme deficiency of potash, lime or magnesia, can sugar cane be prevailed to take up soda. In this case, where only traces of these

elements were present in the sand, the cane has assimilated relatively large quantities of them in comparison to the considerable excess of sodium chloride put at the disposal of the plant.

Furthermore, I analysed the juice of a plot of canes which was planted in a hollow place on very salt land, and even after 12 months had not exceeded the height of one meter and a half, green leaves included. They presented a miserable aspect and were practically dying when I had them cut and the juice analysed. In this extreme case the amount of soda was only one-third of that of the potash, though of course the soda salts must have been very abundant there.

From these investigations we draw the conclusion that sodium chloride extracts potash, lime and magnesia, from the soil and puts these elements at the disposal of the plants; and, next, that sugar cane assimilates in the first place the potash, in a much inferior degree lime and magnesia, and finally, if there is nothing else to be had, also soda. Substitution of potash by soda in the cane is not possible, for in the case of almost total absence of potash the cane did not grow further, and the soda found on analysis in the juice of such cane is not to be considered as a substitute for potash in a sound organism but rather as the choking of a diseased body with useless material.

The varying percentage of soda in cane molasses, which, as we mentioned before, in every case remained far below the potash figure, finds its explanation in the greater or smaller facility with which the soil elements are attacked by salt.

This same subject offers me an occasion to review some apparently contradictory conclusions met with in current literature. In Java the presence of salt in the land is generally considered as pernicious, and very often a sudden withering and death of the cane is ascribed to salt land, whilst sometimes rightly or wrongly an adverse influence is set down to rather feeble concentrations of that body. From other cane-growing countries, however, we receive reports that, on the contrary, sodium chloride is considered as necessary for the success of the crop, for which reason sugar cane is often watered with salt water. A couple of quotations may prove this.

Phipson says in *Sugar Cane*, 1894, page 526:—

"In several West Indian soils the amount of chlorine is very small, if not entirely absent, often a mere trace, whilst in all others it is present in comparatively large amount. Now, it is precisely these soils in which I have remarked this deficiency of chlorine, of which complaints have been made with regard to their poor yield of sugar. I also remember hearing of some Barbados and Trinidad soils that were improved by irrigation with sea water. We have here probably a new light thrown upon the conditions of fertility of cane soils which has hitherto escaped attention. I am convinced that any cane soil taken at the depth of about one foot below the surface which does

not show a proper amount of chlorine, will be found on complete analysis to be deficient in many other necessary ingredients, whilst if chlorine is present in normal amount, the other elements of fertility are almost sure to be present in due quantity.

"In an experiment made by Bourgoin d'Orli, where a plantation was divided into two equal parts, one along the sea coast and the other away from it, the former gave by far the best results, and I recollect that good results followed when I advised a certain amount of chloride of sodium to be added to some cane manure destined for Demerara. In another experiment on a rather poor soil a splendid field of canes was obtained on more than one occasion by adding a can of sea water to the cane holes on planting."

In the June number for 1900 of the *Journal d'Agriculture Tropicale*, the editor, Mr. J. Vilboutchevitch, discusses the question whether sugar cane is a halophile plant, and mentions these facts:—Mr. Hason, of Jamaica, writes, that he has applied with the best results salt water irrigation in the district of Rose Hill, on the eastern slope of Mount Santa Cruz. On the estates in the parish of Hanover in Jamaica, sea algaes are used as fertilisers; these are quite soaked with salt water, and besides contain a huge quantity of salt in their tissue. In the district of Glengoff experienced planters declare it necessary to give salt water to inferior plants.

In connection with the experiments mentioned in this paper, there will doubtless exist countries where the mineral substances of the soil are so firmly combined and so difficult to be assimilated that it is an advantage to be able to dissolve these with so cheap an ingredient as salt water, and it is very probable that Phipson and Hanson are right for Jamaica and Demerara in advocating manuring with salt for sugar cane.

But the fact cannot be generalised, and in Java, for instance, I should not advise the manuring with salt, as in the Java soil the potash is so readily available that all experiments with fertilisers made in the last 20 years have proved unanimously that an increase of the soluable potash in the soil by manuring with potash fertilisers did not improve either the tonnage of the cane or its sucrose content. It is therefore useless to fertilise the cane there with potash, and also useless to apply a method apt to raise the solubility of the mineral soil constituents; we can even go farther and declare such a method undesirable, as very probably a high potash content in the cane juice has an evil effect on its purity and on the output of the sugar from the juice. This subject will, however, be treated in a future paper.

A Company, called the Transvaal Beet Sugar Syndicate, Ld., has been registered in London to carry on the business of sugar planters, cultivators of sugar cane, beet and other produce in South Africa.

BRITISH BEET SUGAR FACTORIES.

By Sigmund Stein

(Sugar Expert, Liverpool.)

The problem relating to the erection of beet sugar factories in England, Scotland and Ireland has lately come much nearer to realisation. Since the abolition of bounties on 1st September, 1903, the question has been ventilated in many quarters.

I am very glad to see that the pioneer work I have done for so many years in this country in growing sugar beetroots experimentally in practically every county in England, Scotland and Ireland, is taken nearly everywhere as the basis for calculations and a proof as to the suitability of our climatic conditions for growing sugar beetroots on a large scale.

My reports which I have issued year by year, the analyses I have made, and the statistics I have worked out, have been invariably kept by interested parties and societies, and they find them very useful now that the time has arrived for bringing the project to its realisation. To judge from the increase in correspondence received, the enthusiasm shown in the matter is making itself felt all over this country. This correspondence, during my absence from England, pursues me to all parts of the world. I see now that the people are in earnest, and when I issued last year my report coloured with the most pessimistic views, complaining of the apathy of the country, I had no idea that in a very few months more the tide of opinion would turn.

I am overwhelmed with invitations to give lectures and explanations about prospective beet sugar factories. So far as my professional engagements allow, I have accepted several invitations; but, of course, I could not do so with all, as my time is fully occupied. I have had invitations as well from Ireland and Scotland, but the distance and heavy pressure of work prevents me from accepting for the present; but I hope to go to these districts in the early part of 1906.

As is well known, I have repeatedly given lectures at Ormskirk; I have likewise addressed large meetings of farmers at Lincoln, including one got up by the Lincoln Chamber of Commerce, all dealing with the same subject. On November 14th, I addressed a large and crowded meeting at Kidderminster. The Town Hall was filled, over 800 people being present, including the whole Town Council and the Chamber of Commerce. The meeting was most enthusiastic, and a resolution was passed unanimously declaring that it was advisable to have a beet sugar factory in the Kidderminster district and calling on the Town Council to investigate the matter, and appoint a committee to be called the Kidderminster Beet Sugar Committee.

I have been invited to give a lecture at the Society of Arts, London, on the 6th December, at 8 p.m., to which I would exhort all interested parties to come. Also, by the invitation of the County Council of Essex, I shall be lecturing at Chelmsford on December 8th, at 3 p.m. The question to be discussed at both meetings will be "Shall we manufacture our sugar from British grown sugar beetroots?"

Other lectures are in progress but the dates have not yet been fixed. I do everything I can to instruct my fellow countrymen on this very important question, and I have been able repeatedly, in discussions following my meetings, to disperse any doubts that may have arisen and to show that we can grow sugar beetroots better here than on the Continent, and that the roots are richer and better for manufacturing purposes. I have claimed, and am claiming, that it will pay this country to make sugar from home-grown sugar beet. I do not mean raw sugar. My scheme is to make direct refined sugar, simply by my process, "The Stein process of refining without charcoal." The British beet sugar factory will be a refinery in itself, with the sole difference that it will work without charcoal, and, therefore, 30% cheaper. It will make granulated, crystals and cubes direct from the beet, and it is intended to sell direct to the consumer, thereby saving all expense of distribution.

Since I started my campaign for the establishment of beet sugar factories, and the growing of beetroots, and commenced publishing annual reports, instructions, and pamphlets, many gentlemen have taken the matter up and suggested different schemes. I am most thankful to these gentlemen for their goodwill, but I am afraid that the statements which they have brought forward and published in different papers are not always quite correct, and I am sorry to say are in some cases very misleading, and tend to do more harm than good. Just while preparing this paper I received information regarding a scheme which, to say the least of it, was too ridiculous to entertain and criticize. Its originator has not the faintest idea regarding the *modus operandi* of this industry, and I do not think it would be possible for his proposals to be realised in the twentieth century. I will not go into details as it would carry me too far, I only want to warn my friends not to be taken in by too highly coloured schemes. We had two sugar factories here in this country before, and they failed; and we must prevent another such failure taking place by looking after the erection, the management, and all the different conditions which belong to such an undertaking. When a sugar factory is started in England it must be done on purely commercial lines, well founded, and all the details worked out beforehand, such as concern a good supply of roots, good roads or other means for transportation, plenty of water and good management (commercial and technical). Only under these conditions can we look forward to

the first factory being the nucleus of scores of other factories which would have to be erected to cover our demand for sugar, and to make us independent of foreign countries.

If anything could be more convincing to our countrymen of the advisability of starting beet factories in this country, and growing beetroots on a very large scale, it is the question of the unemployed. Where are the people now who years ago wrote to me "that we have not enough labour in this country to grow sugar beet and to work the same into sugar?" Do we not hear the cries of the hungry at present? Does not the question of the unemployed go like a red thread through all the daily papers, and occupy the attention of every city, town, borough, and county council of our country? The processions of the unemployed are nothing else than the demand of the British working man for his right to work. How long shall we look on and continue to give our people alms instead of wages? The British working man does not want to beg, he wants to work.

If one visits provincial towns one sees large buildings and structures; are these factories or industrial establishments? No. They are workhouses—institutions for the British labourer who is out of work. Instead of workhouses build sugar factories; instead of charity give work; instead of alms give wages—then England will march with the times, and will have her own beet sugar industry.

Through my frequent absence from England this year I could not carry out my experiments of sugar beet growing so extensively as in previous years. I could not inspect the different experimental plots, and devote so much attention to the cultivation as I would like to have done. This year about forty experiments will be recorded. My report for 1905 will be issued at the beginning of January or February, 1906.

THE SUGAR INDUSTRY IN ITALY.

By Ranieri Pini.

It may be said that the culture of the sugar beet in Italy on a large scale is of but recent origin, as the manufacture of sugar in that country did not commence till 1886 or 1887 and did not develop appreciably till 1898.

Count Cavour was the first person to attempt the cultivation of sugar beets; this he carried out in 1836 on his lands in Piedmont. His trials yielded favourable results, but he lacked the courage to erect and start a factory.

He, however, became a large cultivator of beets for purposes of cattle-feeding.

The first Italian sugar works was installed in 1842 at Sarno, in the Neapolitan district; a second at Anagni, near to Rome, in 1870; two

others in 1872, at Rieti, near to Perugia, and at Cesa, near Arezzo; and finally one at St. Martino, near Verona, in 1883.

But owing to faulty installation, lack of commercial experience on the part of the administration, and a defective system of beet culture, every one of these sugar works had to close after one or two years of work.

The Ministry of Agriculture instituted in 1871 experiments in the cultivation of sugar beet at the various agricultural stations, with the result that the value of this branch of agriculture for nearly every part of Italy was duly recognized.

The Italian Government by its law of June 2nd, 1877, established a surtax, that is, an import duty in excess of the excise duty, in order to protect the sugar production of the country. By a law of 1883, it made this protection more marked by fixing the estimation of the excise duty according to the density of the juice.

But in spite of all that, the cultivation of sugar beets remained neglected, and it was commonly said that this industry could not be established in Italy on an economical basis.

In 1886, an intrepid and clever individual, M. Emilio Maraini, a Parliamentary deputy, after making himself thoroughly acquainted with the cultivation of beets and manufacture of sugar, as carried out in other countries, commenced on his own account to produce sugar, making use of the old sugar works at Rieti, which were brought up-to-date.

The practical success of this cultivation of sugar beets in the district around Rieti, and the sound working of the Maraini sucrerie proved the first step in the subsequent rapid development of beetroot sugar cultivation in North and Central Italy, and led to the planning of several new sugar works.

To-day Italy has almost 40,000 hectares (98,800 acres) under beet cultivation. The official figures for the 1903-04 campaign show a production of 130,860 metric tons of sugar. At present the number of sucreries at work in Italy is 34.

The province of Ferrara cultivates the largest amount of beet. It has five sucreries, cultivates almost 4,175 hectares, and produces annually about 136,000 tons of beets. There will, moreover, be very shortly a large beet distillery in operation.

The Italian sucreries almost all belong to joint stock companies, and several of them have their offices in Gènes. Two establishments belong to Belgian companies, and one to a French concern.

In 1900 a "co-operative sugar works" was erected at Ferrara by a company composed of the large proprietors and growers in that district. It has now been at work for three years under the management of Prof. Aducco, but just lately was sold at a profit to an Italian company, which possesses some other sucreries as well.

Most of the Italian sucreries have been installed by Austrian or German houses; Messrs. Breitfeld Danêk & Co. of Prague, have been responsible for sixteen of them.

The managers of these works are nearly all foreigners. But last year a sugar and distillery course was started at the Ferrara University with a view to producing efficient managers and directors from the Italian students.

In May 1904 all the Itatian sucreries joined to form an Association, called the Unione Zuccheri (Union of Sugar Manufacturers), with headquarters at Milan; this Union had for its principal object the regulation of the quantity of sugar to be produced by the collective establishments and the arrangement of prices. It was desired to prevent over production, with its inevitable troubles.

The home consumption of Italy is lower than that of any other nation, owing to the sugar being heavily taxed. In the mean, it is no more than 3 kg. per head of population. The native raw sugar of 94° pol. pays a manufacturing tax of 67·20 fr. per 100 kg., and foreign sugar pays 88·35 fr. in all for the like amount. Native refined sugar is liable to a duty of 75·15 fr. per 100 kg., and foreign refined one of 91·30 fr. Molasses of a lower quotient of purity than 63° are exempt from duty; they are sold to the distilleries. The production, imports and exports of sugar for the last seven years have been as follows, according to the official figures:—

Year. (1st July–30th June.)	Production.	Imports.	Consumption.
1897-98	3,877	74,207	78,084
1898-99	5,972	75,337	81,309
1899-1900	23,116	58,443	81,559
1900-01	60,125	39,963	100,088
1901-02	72,499	26,942	99,441
1902-03	95,409	10,071	105,480
1903-04	130,860	3,619	134,479

The question of increasing the consumption of sugar in Italy is now under consideration, and pressure is being brought to bear on the Government to reduce the duty. Any such reduction would certainly increase the consumption, because the present retail price of sugar is higher in Italy than anywhere else. In large towns it amounts to 1·60 to 1·85 fr. per kg.

It is also desired if possible, to export sugar, in which case adherto Articles 1, 2, and 3, of the Brussels Convention would be a necessity; at present, Italy, Spain and Sweden are not bound to observe them, as they have no export trade.

Owing to all this, there is at present no inducement to install new factories. The production is sufficient for the existing consumption. But the very liberal protection afforded by the Italian Government in 1883 with its system of graduated duties has been reduced by the law of July, 1902.

The Italian sugar manufacturers enter into contracts with the land proprietors and cultivators, generally for one year; these latter undertake to cultivate a certain hectarage with sugar beets. They fix a price for the beets f.o.b. at the railway station nearest to the fields, or at the sucrerie, and according to the time of delivery. Delivery commences in general about August 1st, and ends by October 15th. The highest prices are paid during August; after that they diminish every fortnight. The best prices are from 2·30 fr. to 2·40 fr. per 100 kg. of beets f.o.b., at the grower's railway station. The last deliveries bring 2 to 2·10 fr. Beets delivered at the factory will, of course, fetch more. Attempts have been made to pay for beets according to their saccharine richness; but in practice the determination of the saccharose content leads to disorder if not to disputes. A few of the sucreries have allowed this favourable method in the case of large and experienced cultivators.

The manufacturer supplies the growers with the seed required at the price of 1 fr. to 1·20 fr., per kg. This seed is supplied almost entirely by German firms, especially by Messrs. Dippe, Braune, Jaensch, Rabbethge, and Gieseke. The most commonly employed variety is the *Klein Wanzleben*.

Professor Aducco has carried out some experiments at Ferrara over a period of several years with a view to demonstrating the respective quantities produced, and saccharose content of beets grown from the seed belonging to various firms. He has concluded that the variety most suitable both to the growers and the manufacturer, *i.e.*, the one possessing the best average in weight and in saccharose content, is the original *Klein Wanzleben*, produced by the firms Dippe, Braune, Rabbethge; and the *Braune spec.*

Some attempt has been made in Italy to produce selected beet seed of native origin. Special cultures have been grown in the Ferrara and Avezzano districts. In all probability they will be eventually successful, because the Italian climate is very favourable for the production of seed, and in the neighbourhood of Naples several hectares of potherbs and flowering plants are grown exclusively as seed plants to supply certain German and French firms.

Some of the sucreries encourage the growers by supplying them with chemical manures and with money to defray the cost of cultivation. These monetary advances are retained as eventual payments for the the beets delivered. In such districts as are worked by small and impoverished cultivators, the sucreries have done much to further the cause of agriculture by their advances. They have also contributed to extending the use of chemical manures, which were almost unknown in Italy previous to the development of the beet sugar industry.

Several sucreries make free grants of pulp to the growers, in amounts corresponding to 30 per cent. of the weights of beet supplied to the factory.

Tillage is in general sufficiently thorough for the beets. German ploughs are much used and do their work well. In the provinces of Ferrara and Bologna, where the soil is pretty hard, and where tillage has to be carried out to a good depth and more efficiently than in the other provinces, a large native plough is employed which is drawn by 10 or 12 oxen and works to a depth of 16 to 20 inches.

The manure is generally turned in with the deep plough. When the ordinary manure is lacking, oil cake is buried in the soil. The most experienced agriculturists add 400 kg. of superphosphate per hectare and two to five metric tons of runnings as they leave the sucrerie. These sugar runnings are not as much appreciated in Italy as they deserve to be. At the same time in those provinces where agricultural methods are sufficiently advanced, the supply of runnings is not equal to their demand by the agriculturists.

In some districts green manures, consisting of red clover, kidney beans and lupines, are turned over into the soil. The more intelligent cultivators prefer to treat the ground with superphosphates and sugar-works scums at the time of the sowing of a grass crop and before the blades appear above ground.

The employment of chemical manures is becoming more general, especially superphosphates, which are placed in the rows at seed-time. Careful experiments have shown that this method is the preferable one. The best authorities employ 300 to 400 kg. of superphosphate, and 150 to 200 kg. of sulphate of potash. It may be remarked that in Italy potassic manures do not give the same results in every soil, because many of the soils contain a considerable natural supply. On the other hand, the addition of phosphate manures has always augmented the crop.

Comparative trials have been carried out to demonstrate whether sulphate or chlorate of potash is the best to use; they gave identical results, but many users prefer sulphate.

Kainit employed in the autumn and winter to the extent of 600 kg. per hectare by Professor Munerati gave splendid results, possibly owing to the amount of magnesia contained in this manure.

A covering of nitrate of soda, generally 150 kg. to the hectare, is very generally employed. It is applied at two periods, one part after the thinning and the other after the second weeding. Some agriculturists use as much as 250 kg. of nitrate of soda without in any way affecting the purity of the juice.

Experiments have been made to ascertain the value of rolling the soil before sowing the beets, and the practice is becoming more general on light soils than on heavy ones. Trials extending over several years show the value of rolling to obtain an early and even crop. The rollers should be fairly heavy. Some farmers use the roller after sowing, and are much satisfied with the results of compressing the soil around the seed. Rollers are also sometimes fitted to the seed drills.

As a rule, the beets are sown in rows 35 to 45 cm. (14 in. to 18 in.) apart. When cultivation is on a large scale a machine is used; the small farmers sow by hand, covering up the seed carefully with as little soil as possible. About 20 kg. of seed per hectare is usually employed.

In some of the provinces it is becoming the custom to sow the beet seed in holes. This method is favoured for the following reasons:—

(i.) The seed is economized, as only 10 to 12 kg. per hectare are required.

(ii.) It facilitates the application of the superphosphate at the time of sowing, and this manure aids the early growth of the plant.

(iii.) It simplifies the thinning out.

(iv.) The interspaces are more regular, and, as a consequence, the vegetation is more vigorous.

At Rovigo, an agriculturist, named Casalini, has invented a very simple and economical "pocket" sowing machine, which enables a large area of land to be sowed in one day with the aid of women and children.

Seed-time in Italy begins in the first week of March and terminates by the middle of April, according to the temperature of the particular district. At Caserta and around Naples, splendid beet crops have been obtained by sowing about the middle of February; but these districts possess a semi-tropical climate.

Experiments have shown the wisdom of thinning out early, and of repeating the operation at the first time of weeding. Distances of 20 to 25 cm. are the most usual. A second weeding, and then the heaping up of the soil follows. American hand hoes and also horse hoes are much used.

The beet-pulling is done either by hand or else by old wooden ploughs; mechanical pullers are also employed.

It is gratifying to record that so far no diseases have become prevalent in the Italian sugar beet agriculture. Some noxious insects, such as the *Melolontha vulgaris*, the *Pentodon punctatus*, the *Haltica nemorum*, and the *Noctua*, are all known, but their depredations are almost insignificant. Vegetable parasites, such as the *Peronospora Schachtii* and the *Uromyces betae*, have attacked the plants for some years, but without doing any appreciable damage.

Below will be found the results of analyses which have been carried out by Professor Menozzi, Director of the Royal Laboratory of Agricultural Chemistry at Milan, during the months of August and September, 1904, on beets of the "Special" variety from the firm of Jaensch, Ascherleben, and which were grown in different provinces, as the result of a competition initiated by the firm of Ingegnoli, of Milan:—

Province.	Per cent of Sugar.	Sugar per hectare of beets. Kg.
Aquila	15·40	7,000
Bologna	13·50	7,900
Forli	14·25	3,800
Grosseto	15·49	4,700
Mantova	16·40	7,000
Modena	12·39	7,700
Perugia	14·80	7,100
Piacenza	17·21	4,100
,,	14·40	4,600
,,	10·05	5,100
,,	17·11	6,300
,,	15·30	6,900
Ravenna	16·83	7,900
,,	15·80	7,400
,,	16·00	4,600
Rovigo	16·20	6,700
,,	16·00	8,600
Siena	16·03	5,400

(Translated from the *Sucrerie Belge.*)

MONTHLY LIST OF PATENTS.

Communicated by Mr. W. P. Thompson, C.E., F.C.S., M.I.M.E., Chartered Patent Agent, 6, Lord Street, Liverpool; and 322, High Holborn, London.

ENGLISH.—Applications.

20808. J. Pickering, Glasgow. (Communicated by W. E. Dixon, New South Wales.) *A continuous centrifugal separator for treatment of sugar and other materials.* 14th October, 1905.

20810. R. Harvey, Glasgow. (Communicated by J. P. Rodriguez, Cuba.) *Improvements in and relating to mills for crushing sugar cane or like material.* 14th October, 1905.

20811. R. Harvey, Glasgow. *Improvements in and relating to appliances for treating crushed cane or megass.* 14th October, 1905.

21072. K. Dorant, London. *Process for refining sugar.* (Complete specification.) 17th October, 1905.

21848. C. Sassin, London. *Improvements in mills for crushing sugar cane or the like.* (Date applied for under Patents Act, 1901, 27th October, 1904, being date of application in France.) (Complete specification.) 26th October, 1905.

22375. W. H. Holloway, Liverpool. *Improvements in sugar crushers for table use.* 2nd November, 1905.

GERMAN.—ABRIDGMENT.

162955. W. O. LUTHER, of Brühl. *A process for obtaining beetroot sugar whilst avoiding bi-products.* 19th January, 1905. In the process for obtaining beetroot sugar described in this patent, in which bi-products are avoided and materials containing tannin are employed as purifying materials, the fresh shreddings are brought into a hot solution containing tannin (which is obtained by purifying the drain from first products by means of materials containing an excess of tannin, and heat,) and mashed in the ordinary way and then pressed, whilst the juice obtained is further treated to form sugar in the usual manner.

163361. HEINRICH WINTER, of Charlottenberg. *A process for making beetroot sugar resembling cane sugar.* 7th August, 1904. (Patent of Addition to Patent No. 147627 of 28th February, 1902.) This improvement, in the process described in the British Patent No. 147627, is characterised by the casing syrup, containing invert sugar or other hexose, being strongly super-saturated with saccharose, then centrifugalled over a layer of sugar crystals, and finally allowed to stand, for the purpose of obtaining a powdered sugar having the character of cane sugar.

163444. S. DUFFNER, of Brunswick. *Evaporating apparatus.* 9th March, 1904. This evaporating apparatus is provided with cylindrical heating bodies combined in stages into a heating arrangement, in which the vertical heating tubes of the separate heating bodies are arranged in mutual prolongation of one another, and is characterised by the separate heating bodies having a progressively decreasing or increasing or otherwise varying diameter, and lying one over the other in such a way that a space quite sufficient for the unimpeded upward movement of the circulating mass remains between the heating bodies and the wall of the vessel.

IMPORTS AND EXPORTS OF SUGAR (UNITED KINGDOM)

To end of October, 1904 and 1905.

IMPORTS.

Raw Sugars.	Quantities. 1904. Cwts.	Quantities. 1905. Cwts.	Values. 1904. £	Values. 1905. £
Germany	5,175,987	4,385,748	2,377,715	2,483,807
Holland	405,291	137,359	205,719	84,650
Belgium	551,925	499,522	273,292	310,755
France	473,627	404,116	247,266	235,717
Austria-Hungary	688,203	373,540	310,628	244,871
Java	1,679,414	1,922,558	780,581	1,307,662
Philippine Islands	87,025	9,023	31,165	4,840
Cuba	....	....	....	....
Peru	900,394	1,081,387	423,311	696,675
Brazil	83,257	93,938	31,607	50,426
Argentine Republic	....	....	....	....
Mauritius	525,292	167,007	198,838	91,001
British East Indies	79,319	256,180	30,115	143,662
Straits Settlements	113,498	187,381	48,204	100,025
Br. W. Indies, Guiana, &c.	840,288	930,915	543,045	746,323
Other Countries	434,944	747,325	202,659	500,189
Total Raw Sugars	12,038,464	11,195,999	5,704,145	7,000,603
Refined Sugars.				
Germany	8,697,125	7,671,223	4,962,330	6,058,245
Holland	2,613,080	1,416,790	1,587,958	1,134,204
Belgium	432,690	245,668	253,682	191,041
France	2,368,859	1,960,018	1,356,885	1,395,893
Other Countries	179,991	345,813	95,370	283,653
Total Refined Sugars	14,291,745	11,639,512	8,256,225	9,063,036
Molasses	1,148,703	2,073,149	271,067	417,053
Total Imports	27,478,912	24,908,660	14,231,437	16,480,692

EXPORTS.

British Refined Sugars.	Cwts.	Cwts.	£	£
Sweden	2,470	1,003	985	464
Norway	24,472	17,515	15,394	13,181
Denmark	90,166	75,123	46,191	52,131
Holland	55,152	67,330	30,363	51,256
Belgium	9,709	8,102	5,325	5,022
Portugal, Azores, &c.	16,757	13,088	9,224	9,258
Italy	3,508	8,758	1,676	5,454
Other Countries	304,472	325,038	199,811	272,048
	509,706	515,957	308,969	408,814
Foreign & Colonial Sugars.				
Refined and Candy	21,327	21,140	14,847	18,068
Unrefined	93,258	83,994	51,778	57,830
Molasses	1,835	2,752	1,022	840
Total Exports	626,126	623,843	376,616	485,552

UNITED STATES.

(Willett & Gray, &c.)

(Tons of 2,240 lbs.)	1905. Tons.		1904. Tons.
Total Receipts, Jan. 1st to Nov. 16th ..	1,754,378	..	1,785,775
Receipts of Refined ,, ,, ,, ..	1,233	..	569
Deliveries ,, ,, ,, ..	1,678,039	..	1,794,651
Consumption (4 Ports, Exports deducted) since January 1st	1,611,390	..	1,712,322
Importers' Stocks November 15th.. ..	76,339	..	3,285
Stocks in Cuba, November 29th	88,000	..	1,250
Total Stocks, ,, ...	214,000	..	129,050
	1904.		1903.
Total Consumption for twelve months ..	2,727,162	..	2,549,643

CUBA.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1904 AND 1905.

(Tons of 2,240lbs.)	1904. Tons.		1905. Tons.
Exports	1,078,906	..	945,063
Stocks	16,916	..	172,498
	1,095,822	..	1,117,561
Local Consumption (nine months)	32,721	..	32,120
	1,128,543	..	1,149,681
Stock on 1st January (old crop)	94,835	..	——
Receipts at Ports up to 31st August ..	1,033,708	..	1,149,681

Havana, September 30th. 1905. J. GUMA.—F. MEJER.

UNITED KINGDOM.

STATEMENT OF IMPORTS, EXPORTS, AND CONSUMPTION FOR TEN MONTHS ENDING OCTOBER 31ST.

SUGAR.	Imports. 1903. Tons.		1904. Tons.		1905. Tons.	Exports (Foreign). 1903. Tons.		1904. Tons.		1905. Tons.
Refined	809,884	..	714,587	..	581,976	1,789	..	1,066	..	1,057
Raw	524,526	..	601,923	..	559,800	2,647	..	4,663	..	4,200
Molasses	64,221	..	72,435	..	103,657	93	..	92	..	138
Total	1,398,631	..	1,388,945	..	1,245,433	4,529	..	5,821	..	5,395

	Home Consumption. 1903. Tons.		1904. Tons.		1905. Tons.
Refined	757,276	..	728,027	..	583,174
Refined (in Bond) in the United Kingdom	16,692	..	438,778	..	460,144
Raw	402,357	..	106,593	.	86,696
Molasses	58,990	..	70,914	..	102,235
Molasses, manufactured (in Bond) in U.K.	4,377	..	50,034	..	45,167
Total	1,239,692	..	1,394,346	..	1,277,416
Less Exports of British Refined	42,433	..	25,485	..	25,798
Total Home Consumption of Sugar	1,197,259	..	1,368,861	..	1,251,618

Stocks of Sugar in Europe at uneven dates, Nov. 1st to 29th, compared with previous Years.

In thousands of tons, to the nearest thousand.

Great Britain.	Germany including Hamburg.	France.	Austria.	Holland and Belgium.	Total 1905.
99	678	476	365	132	1751

	1904.	1903.	1902.	1901.
Totals	1568	2097	1905	1640

Twelve Months' Consumption of Sugar in Europe for Three Years, ending October 31st, in thousands of tons.

(Licht's Circular.)

Great Britain.	Germany.	France.	Austria.	Holland, Belgium, &c.	Total 1904-5.	Total 1903-4.	Total 1902-3.
1590	897	586	461	165	3701	4175	3697

Estimated Crop of Beetroot Sugar on the Continent of Europe for the current Campaign, compared with the actual crop of the three previous Campaigns.

(From Licht's Monthly Circular.)

	1905-1906. Tons.	1904-1905. Tons.	1903-1904. Tons.	1902-1903. Tons.
Germany	2,300,000	1,595,100	1,927,681	1,762,461
Austria	1,460,000	889,400	1,167,959	1,057,692
France	1,000,000	622,100	804,308	833,210
Russia	1,020,000	950,000	1,206,907	1,256,311
Belgium	325,000	173,800	203,446	224,090
Holland	200,000	136,500	123,551	102,411
Other Countries	420,000	340,000	441,116	325,082
	6,725,000	4,706,900	5,874,968	5,561,257